SIXTY-NINTH YEAR

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The Triumphal Gateway of the goddess Ishtar and the processional road of the god Marduk. The gateway consists of six square pillars, three on each side, forty feet high and twelve feet broad. In the background is the mound of Kasr, or the royal city mound of Nebuchadnezzar.

EXCAVATING BURIED BABYLON.—[See page 357.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *snappy*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Control Reservoirs and the Dayton Flood

NOTHING is more greatly needed just now, in any discussion of the proper methods of control of the Mississippi River and its tributaries, than a proper point of perspective and a reasonable sense of proportion. The area covered by the watershed of the Mississippi is so vast, and the localities affected by the floods are separated by such great distances, that the point of view, even of the most serious and earnest lay student of the problem, has been altogether too limited—too much affected by what the thinker or writer or speaker happens to see with his own eyes.

In the presence of such a flood as that at Dayton, Ohio, we are apt to believe that the rainfall was absolutely unprecedented. As a matter of fact, it is probable that from time immemorial the rainstorms of the Mississippi watershed, both in the intensity and the duration of the precipitation, have been just about the same as they are to-day. The Dayton flood was in no sense the act of God—rather it should be termed the price which we pay, in this particular direction, for our modern civilization. The floods are the result of the industry of the pioneer with his ax and plow, and of the modern farmer and road-builder, with the ditching and drainage and the constant effort, direct or indirect, to get the water which falls from the clouds as quickly as possible into the river channels.

In olden days, when the districts affected by the recent rainfall were covered with dense forests, and denser undergrowth, it took from two to three weeks for the water to get into the rivers. To-day, thanks to the general clearing up and cultivation of the country, the water from rainstorms of the same magnitude will be in the rivers within two or three days' time. On the other hand, while the farmer has been smoothing the way for a rapid run-off of the water, the dweller in the cities has been encroaching steadily upon the channels which nature has prepared and found sufficient to carry the flood waters comfortably down to the sea. By piling and bulkheading, areas, which properly belong to the high-water channel, have been mulcted therefrom for the erection of factories, wharves and warehouses. Bridges have been thrown across the channels, frequently with massive piers and lengthy abutments, reducing the total cross-section available for the flow of the water fully fifty per cent below that which nature had found to be necessary at a time when the run-off of the rainstorms, in any given period of time, was only from one fifth to one tenth of what it is to-day.

Can the floods be prevented by reforestation? Yes—provided the farmers will vacate their lands and the Government will replant them and allow the flood lands of the upper Ohio to return to nature's wilderness conditions, and if the citizens of Dayton and other towns subject to floods will blow up their bridge piers and approaches, and raze all artificial structures until the river is restored to its original capacity. We are not prepared to do that, of course. Therefore, the only way to restrain the river under the new conditions bought about by civilization, is to build levees of sufficient height to contain the flood waters and guide them safely to the Gulf. Reforestation, we heartily believe in. It should be done for the sake of the future timber supply of the country, and it should be done on all areas which are not suitable for agriculture.

Can such floods as that at Dayton be prevented by building reservoirs of such capacity as to hold back the flood waters and let them into the rivers, in such volume and over such periods of time as we might wish? Yes; the thing could be done; but it would involve an equal wiping out of cultivated lands to that demanded for adequate reforestation. Let us consider a few figures. At the height of the recent flood, the amount of water to be taken care of was such that if a reservoir of the size of Lake Erie had been available for storage, twenty-four hours of that rainstorm would have caused a rise of six inches over the whole surface. Think of that—sufficient water falling in one day to raise Lake Erie six inches!

Furthermore, if our Lake Erie storage basin were built to cover the area concerned in the flood of last month, it might happen that the next great rainstorm, say the following year, would fall not in the upper Ohio, but in the upper Mississippi, or in the central Mississippi, or elsewhere, and our reservoir of the size of Lake Erie would be merely a costly testimonial to the fact that we had not taken a proper bird's eye view of the whole situation.

Reforestation can help a little; and reservoirs can help a little; but the true solution of the problem lies in pushing to completion an adequate system of lofty, strongly-built, and properly reveted levees throughout the districts that are subject to overflow.

Knowledge and Morals

OUR civilization has brought with it evils of its own. We teach the young to enable them to earn a living, to appreciate art, and to make reasonably good citizens. But in the matter of sexual enlightenment our attitude is almost wholly negative. We treat the subject as something "not quite nice to speak about," and leave the young generation to discover the truths of life at haphazard—with the result that their information is gained through any but good channels. In the primitive state of society, competent authorities tell us, due attention was paid to these things. We, with our "higher civilization," leave it to the coarser elements to "enlighten" the rising generation, while the "better" elements maintain a prudish silence. And thus vice is bred of ignorance.

These things are not as they should be, and many voices are being raised to-day, calling for a reform of our customs. The problem is a difficult one, its solution calls for our most thoughtful efforts. The phenomena of sex are so complex in their influence upon the life of body and soul, and affect so many phases of our being, that a well-balanced attitude toward these things is absolutely essential if we are to escape the danger of a one-sided and distorted point of view. Thus, the extremist, who would elevate free love upon a pinnacle of glory, and make all things else subservient to this one principle, forgets the exigencies of practical life. On the other hand, any plan which proposes utterly to disregard deep-rooted instincts of our nature can but lead to failure. In this the advocates of eugenics have shown their good judgment, that they have for the main restricted their plans to negative measures: they urge us to prevent obviously undesirable unions, the marriage of imbeciles, criminals, habitual drunkards and other burdensome and harmful elements of the population. How much good such negative measures alone would do, if enforced, is obvious to any one familiar with the history of such nests of vice and crime as the Jukes and Zero families. What we need is frank and sincere discussion. Let not those who by their sense of the sanctity of the issues involved are best qualified to speak, be held in silence by an exaggerated or false modesty. It is in this spirit that we welcome the expressions of V. Jefferson Watts on the subject of "Knowledge and Morals" in the current issue of our SUPPLEMENT.

Possibilities of the Home Laboratory

IN these days of magnificent endowment, by means of which every field of science is so ideally developed and brought to fruition, one is apt to discount the possibilities of the home laboratory. There may be some who are deterred from entering those Elysian fields by the reflection that isolated contributions to science would be lost in the vast output of our splendidly equipped institutions. The consideration of a few instances will demonstrate that there is no occasion for any individual enthusiast to be deterred because he may not be so fortunate as to be associated with a great scientific enterprise; given brains and industry it is amazing what can be done with a very modest equipment indeed. For example:

When Koch in 1882, announced his discovery of the tubercle bacillus, Dr. Edward L. Trudeau was living at Saranac Lake, whence he had gone to cure himself (how beneficient has the result since proved to thousands!) of tuberculosis. Saranac Lake was then but a guide's settlement, remote from civilization, desolate in its surroundings, forty miles from any railroad. Dr. Trudeau secured a copy of Koch's epochal paper; and, being without special training, he went to New York to receive a few lessons from a colleague in the essential principles of bacteriology, and how to stain the tubercle bacillus.

At Saranac Lake, then, without paraphernalia other than his microscope, without access to great libraries containing manifold treatises on the subject, the water often turned to ice in his house (his wood stove would not generally burn all night, nor was there at that time any coal in that region) Dr. Trudeau devised a home-made thermostat which had no regulating apparatus and was heated only by a small kerosene lamp. For protection against violent changes in temperature he inclosed his thermostat in a series of wooden boxes, the doors of which could be opened or closed at will, according to the intensity of the cold. His guinea pigs he kept in a hole under the ground, heated by an oil lamp, this being the only spot in Saranac Lake where they could escape freezing at night. (The Saranac temperatures may be lower than that which Amunsden experienced at the South Pole.) Under such circumstances as these did Dr. Trudeau obtain the tubercle bacillus in pure culture, being the second observer in America to do this; and with these cultures he repeated all of Koch's inoculation experiments. Since then the Laboratory of the Adirondack Cottage Sanitarium has held and holds a place in science of primary importance as to its contributions and influence.

As to Koch himself: At seventeen he persuaded his father to get him a microscope, as another youth might strive for a fowling piece or another for a motor car. Possessed of this most congenial companion he set about perfecting other technical means of investigation. Even genius cannot work effectively without tools; so Koch himself took a hand in the making of just such tools as he wanted and needed. After obtaining his degree in medicine he became a simple country doctor, utilizing his spare time (what young doctor has not of this commodity aplenty) in scientific study, experimentation, research and writing; but not until he had something to write about. In those obscure years, as yet unenrolled in any world-famous institution, he laid the foundation of all that noble work which earned for him the title *The Father of Preventive Medicine.*

The Abbe Mendel, a simple priest, experimenting on peas in a cloister garden, evolved the most valid theory of heredity known to science. The Curies revolutionized the physical sciences by their discoveries in most unpretentious laboratories. The clergyman, Spellanzani, started physicians investigating digestion by making a dog swallow a perforated wooden ball into the hollow of which meat had been introduced, in order to learn if this is digested in the stomach by means of a ferment or through attrition by the gastric muscles. It is good for example to have richly equipped physiological laboratories, and we should be grateful for them, but their fruits come essentially from the geniuses working in them; a wonderfully successful teacher of physiology got that science through even the thickest head in his classes by the agency of his personality, half a yard of string, a blackboard and some colored chalks.

The Scientific American in the House of Representatives

SPEAKING recently on the subject of the Mississippi River problem, the Hon. Benjamin G. Humphreys, Representative from Mississippi, included an editorial from the SCIENTIFIC AMERICAN of February 15th, 1913. The Representative said: "Mr. Speaker, under the leave granted to me to extend my remarks in the *Record* I include an editorial from the SCIENTIFIC AMERICAN on the subject of the problem of the Mississippi. Since the digging of the Panama Canal this is the most serious and most important problem which Congress will have to deal with. All three of the political parties represented on this floor are committed by specific declarations in their several platforms to the task of preventing floods on the Mississippi River and I commend unreservedly to their careful consideration this editorial, which states the problem and the sole method of its solution more pointedly and concisely than I have ever seen it stated before.

"Every man here will concede that the SCIENTIFIC AMERICAN is one of the most conservative, accurate, and well-advised journals on all technical subjects published in this country, and its conclusions on this particular problem will certainly carry weight, if not conviction, to every open mind. Few gentlemen here have the time which it is necessary to devote to the study of the Mississippi River, and I hope, therefore that you will read this editorial, which will cover less than two pages in the *Record*, and yet which covers the whole subject.

"Reservoirs, outlets, and other kindred theories are studied and their fallacies exposed, and the levee theory, which all who are informed on this subject agree is the only feasible way to control the floods, is fully endorsed. I do hope that every member here will read this editorial, because it illumines a subject that we will soon be called upon to consider and finally settle."

Engineering

Progress on the Cape Cod Canal.—It is estimated that the 25,000,000 tons of shipping which rounds Cape Cod during the year will be so far benefited by the opening of the Cape Cod Canal that it will be perfectly willing to pay a toll for the use of the canal. The 11,000,000 tons of coal shipped annually to eastern ports will find the inner and sheltered route of great advantage and probably the greater part of this, or such part as is carried in barges, will avail itself of the canal.

Decline in Relative Strength of the American Navy.—Already the United States Navy has lost the second position in rank among the naval powers. Germany has surpassed us, and now we are confronted with the probability of having to give place to France, whose navy under the new administration has taken on new life and is advancing by leaps and bounds. The relative positions of the two fleets in 1916 will be France, ten dreadnoughts, the United States, eight; France, seven superdreadnoughts, the United States, five. In that year the total displacement of dreadnoughts and superdreadnoughts will be 376,000 tons for France and 310,000 for the United States.

Switzerland Buys the St. Gothard Railroad.—The acquisition of the St. Gothard railroad by the Swiss government has been advanced by the ratification by the National Council of the St. Gothard Railway Convention of 1909, by which the St. Gothard railway passes into the hands of the Swiss government. The company is paid $42,500,000 for the railroad, and in addition the government takes over the debt of the company, which amounts to $23,418,000. This line, one of the most famous engineering works in the world, was the first to introduce those famous loops built entirely within the body of the mountain.

A School Which Pays Its Scholars.—For six years the apprentice school at the Lehigh Valley Coal Company's shops at Drifton has been in successful operation. It is held for one hour twice a week during working hours, and a novel feature is that the scholars are paid at their regular rates for this time. Attendance is compulsory for all apprentices. They are instructed in the applied mathematics of mechanics, freehand drawing, correspondence, and all subjects useful to them in their craft. One of the earliest scholars could neither read nor write, yet to-day he is considered one of the best workmen in the shop. The average attendance is about twenty, and the course is pronounced by visitors from nearby institutions of learning to be both efficient and complete.

Over-taxation Limits Size of Cities.—In a recent issue of the *Wall Street Journal*, attention is drawn to the fact that the final determining factor in the growth of cities is the taxation, which history has shown us tends to run to very high and burdensome limits in the greatest and most rapidly growing cities of the world. Attention is drawn to the fact that Mommsen has shown that the water-tax receipts proved that in the time of Hadrian the population of Rome was not less than 1,400,000. To-day it is less than 400,000, and our contemporary draws the conclusion that the people were taxed out of the city. London has slowed down in its rate of growth, and attention is drawn to the fact that increasing taxation, due to the very costly works of improvement now being undertaken, may ultimately act with similar effect on the city of New York.

Sixteen-mile Tunnels Through the Rockies.—One of the most striking developments of present-day engineering is the great expense which the railroad companies do not hesitate to incur in building tunnels of unprecedented length with a view to decreasing their grades across the mountain summits. The latest announcement in this connection is that of the Canadian Pacific Railroad, which states it is going to undertake the construction shortly of a tunnel that will be by far the longest yet constructed. It is to be built below its pass through the Rocky Mountains. It will be 16 miles in length and will cost $14,000,000. This is some four miles longer than the well-known Simplon Tunnel through the Alps and the estimated time of construction is seven years.

Figures of a Four Days' Rainstorm.—The Weather Bureau estimates that in the four days' rainstorm which devastated certain towns and villages in the upper watershed of the Ohio River, sufficient water fell to cover fifteen million acres of land to a depth of one foot. This represents between five and six thousand billion gallons of water. In the presence of such eccentricity of nature, the works of man, whether they be restraining reservoirs or artificial banks or what not, become mere pygmies and utterly futile for restraint. A four-day rainfall which will cover such a State as Ohio with a depth of seven inches, is a phenomenon of nature which is beyond all possibilities of control by any appliances that are known in the present stage of engineering knowledge. All we can hope for is to mitigate disaster. Absolutely to prevent it would probably call for works of a magnitude which is utterly beyond our present ingenuity and resources.

Electricity

Wireless Telegraphy Across the Bering Sea.—It is reported that arrangements are being made between our Government and that of Russia to maintain a wireless telegraph service across the Bering Sea. This will complete the girdle of radio-telegraphic communication around the world.

Electricity from Sawdust.—The city of Vancouver, British Columbia, has been greatly annoyed by the smoke from sawmills and lumber mills. To overcome this nuisance, a company has been formed to supply these mills with electric power. As fuel for the generating plant, however, it is planned to use the sawdust from the lumber mills' waste heaps. As the power is obtained in this way from a waste product, electricity can be furnished at greatly reduced rates, and not only is the smoke nuisance abated, but the problem of disposing of enormous piles of sawdust is also solved.

Threading Conduits Pneumatically.—A new apparatus has been designed for threading conduits. It has the advantage of being able to pass around several bends which would be difficult if not impossible with the ordinary fish-tape method. A "traveler" is provided which consists of a series of washers loosely fitting the interior of the conduit. This traveler is connected to a string or cord which passes through a tube into a compressed-air tank where it is coiled up on a reel. In service, the tank is first filled with air to a pressure of about 20 pounds by means of a hand pump, then the traveler is inserted in the conduit, the end of which is sealed by a plug on the end of the tube, and a valve is opened, permitting the air to pass out into the conduit and blow the traveler through, drawing the string with it. This string is then used to draw wire which, in turn, may be used for hauling a heavy cable through the conduit.

Sterilizing Milk with Ultra-violet rays.—The Bureau of Animal Industry has been carrying on a number of experiments at Washington, D. C., in the use of ultra-violet rays for the sterilization of milk. The milk is spread out in a thin layer by means of a drum revolving at high speed, which picks up the milk from one trough and conveys it to another. While on the drum it is subjected to the ultra-violet rays. Then it is picked up from the second trough by a second drum and conveyed to a sterile flask. A quartz mercury-vapor lamp generates the ultra-violet rays to which the thin film of milk is exposed. It has been found that by this treatment the bacterial contents is greatly reduced. However, when the milk is exposed for a sufficient length of time or in a film thin enough to produce a much larger reduction in the bacteriae content, it is given a disagreeable flavor which renders it unfit for the market.

Electrolysis and Concrete Reinforcing.—The effect of electrolysis on the iron reinforcing rods of concrete was demonstrated at the recent Cement Show in Chicago, by an exhibit of the National Bureau of Standards. It was shown that local currents are set up in the iron due to moisture and impurities, producing iron oxide, which, as it occupies a much larger volume than the iron, exerts a pressure that eventually results in cracking the concrete. To determine the amount of this pressure, a steel cylinder with a bore of 1.5-inch internal diameter was fitted with a steel rod of one-inch diameter and the space between was filled with cement. This was then immersed in water and the iron core was connected to an electric circuit. By measuring the expansion of the outer cylinder it was found that the oxidation of the iron core produced a maximum pressure of 4,700 pounds per square inch. A column of concrete, one foot long and six inches in diameter and provided with an iron core, was immersed in water and subjected to fifty volts with the iron core as the anode. In three hours time the specimen was cracked. A bulletin on these experiments is being prepared by the Bureau of Standards.

Self-lighting Kinetoscope.—By the use of a small dynamo mounted along with the crank mechanism of a moving picture machine, the Pathé firm of Paris are now able to produce a machine which is self-contained and furnishes its own current for the lamp. This makes an independent apparatus which can be set up anywhere and is at once ready for use. Where a current supply is not at hand, this will be very convenient. The idea is being applied in a simplified apparatus of recent design, and it is intended to be used extensively in homes or schools, as the picture machine is now recognized to have an educational value, besides giving recreation. One point which lessens complication is the use of an over-volted metallic filament lamp, and by increasing the current much above the standard the lamp gives a very bright light, thus projecting a good image on the screen. Such a lamp will burn for 8 or 10 hours and can be replaced very cheaply. Thus the usual arc lamp, which amateurs may find more difficult to work, is not needed here. The new machine also has incombustible films of prepared celluloid, of somewhat smaller size than the standard. In this way the machine is well within the reach of amateurs, as now there is scarcely anything to be attended to.

Science

The Tercentenary of Logarithms.—The Royal Society of Edinburgh is planning to hold an international mathematical congress in June, 1914, to celebrate the tercentenary of the publication of John Napier's "Mirifici Logarithmorum Canonis Descriptio." The entertainments will include a garden party at Merchiston, of which Napier was laird.

The Names of the Minor Planets, or Asteroids, since the number of known bodies of this class began increasing by leaps and bounds, with the introduction of photographic methods of search, have furnished astronomers with the opportunity of commemorating all sorts of persons and things, mythical and otherwise. One of them, No. 594, has just been named Mireille, after the heroine of a celebrated Provençal poem by Frédéric Mistral. This name was proposed by Camille Flammarion (of course!) and has been accepted by Dr. Max Wolf, who discovered the planet in question in 1906.

Meteorological Work of the "Scotia."—In connection with the forthcoming ice-patrol of the North Atlantic which is being organized by the British Board of Trade and several steamship companies, it is announced that the vessel to be used for this purpose, the "Scotia," will carry a trained meteorologist, and that upper-air observations will be made by means of kites and kite-meteorographs, which have been supplied by Dr. Assmann, director of the Lindenberg Observatory. It is also announced that the wireless equipment of the vessel has been furnished free by the Marconi Company. Two wireless operators will be carried. The vessel will be stationed off the east coast of North America, to the north of the usual shipping routes, to watch the break-up of the ice and report on its movement toward the shipping routes.

A "German-South American Institute" has been founded, with headquarters at the Technical High School in Aix-la-Chapelle, for the purpose of furthering both intellectual and commercial relations between Germany and Latin America. The ambitious programme of this institution includes the interchanges of literature, especially periodical publications; the publication of directories and handbooks for the countries concerned; the preparation of German, Spanish and Portuguese editions of appropriate works on the arts and sciences, and so on. The Institute will be divided into a large number of sections, according to countries and subjects, and each member will affiliate with one or more of these. Further information on this subject may be obtained by addressing the "Geschaftsstelle des Deutsch-Sudamerikanischen Instituts," Kgl. Techn. Hochschule, Aix-la-Chapelle, Germany.

The Highest Mountain Climb.—The account of the Duke of the Abruzzi's expedition to the Karakoram and Western Himalaya in 1909, just published, reports some remarkable altitudes attained by the party. According to the *Geographical Journal*, the Duke undertook this expedition chiefly to contribute to the vexed problem as to how high it is possible for human beings to climb. He and his guides, after living for 37 days at or above 16,000 feet, spent another 17 above 18,000 feet, of which 9 were spent at or above 21,000 feet. In an attempt on Bride Peak, the party camped at 22,483 feet, and the next morning climbed to 24,600 feet—thus carrying the "man-level" 700 feet higher than any previous mountaineer. Only a heavy mist prevented them from reaching the summit (25,110 feet). The most remarkable part of the story is that the party did not suffer from mountain sickness, and were little the worse in any way for their exertions. Apropos of this fact an interesting series of letters on the subject of mountain sickness, from correspondents in various parts of the world, has been appearing for some months in the *Geographical Journal*. There are few subjects on which opinions differ more widely.

Primitive Art.—The numerous discoveries in the way of mural paintings and drawings of paleolithic caverns which have been made in Europe of late are well *resumed* and illustrated in the recent publications made under the auspices of the Prince of Monaco, and the two volumes relate to pictorial art of the epoch known as Magdelenian. The first discoveries made at Altamira, Spain, in 1872, were followed by many others, and these confirmed the existence of a quaternary art of remarkable value. Systematic researches in a great number of caverns showed that this art was spread over other regions, for instance in France, where M. Riviere published the drawings from the La Mouthe cavern in the Dordogne region. Handsome and large-sized polychrome frescoes then came to light in the Combarelles and other caves which belonged to the same family. Then a careful study of the subject was taken up and the publication decided upon, owing to the Prince of Monaco's liberality. Messrs. Capitan, Breuil and others who were active workers, now determine the form and position of the caverns, then give a description of the ornamentation, and draw a parallel between the animal forms and those of existing animals or of animal remains which we possess.

English Multicycles for the Blind

By Frank C. Perkins

THE first multicycle used by the pupils of the Royal Normal College for the Blind was a Rudge Sociable cycle which Sir Francis Campbell obtained. When the double Sociable was developed two of these machines were obtained in 1884, and with two sighted persons to steer, the blind pupils often went on short trips. Sir Francis soon exchanged this Sociable for a tandem, and had two other tandems joined for a four-in-hand.

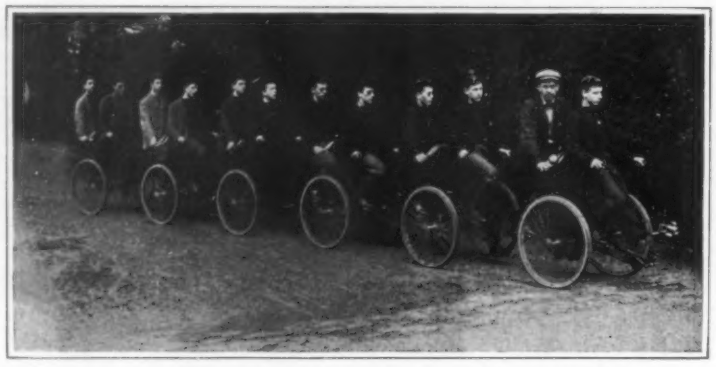
As it was important to have a machine on which one sighted person could steer for more than three blind riders, the multicycle manufacturers were asked to construct a machine to carry eight, and a number of experiments in couplings were tried. Sir Francis with his son and a practical member of the staff of the College for the Blind made several visits to Coventry to test the experimental machines. Finally a satisfactory one was built in 1888 and given to this College for the Blind through the help of Mrs. W. W. Astor, Mr. John Cook, and the principal.

The institution was soon provided with an addition of two six-in-hands, a four and a three, so that a party of twenty-seven blind people could be taken out for an afternoon run. The Singer military multicycle was then developed and a twelve-in-hand was built for the Royal Normal College for the Blind in 1893, and that machine is still in use. It has six pairs of wheels with two riders for one axle, and the six parts are connected by swivel and knuckle joints.

The latest multicycle seen in the photograph is very sensitive to the steering done by the second rider, and it will turn in its own length and can be divided into two sixes or three fours. Its length is 28 feet and it is geared to 51. With this multicycle runs have been made to Derby, Birmingham, Brighton and other towns. Until the motor traffic monopolized the roads, the machine was in constant use by the blind boys and girls and there was no outing they enjoyed more than a run on the Brighton road. There is a track of three laps to the mile in the grounds of this asylum for the blind, where the pupils practise.

For recreation at the Royal Normal College and Academy of Music for the Blind at Upper Norwood, London, England, a number of these college multicycles are used, as shown in the accompanying photographs. A team from this institution for the blind rode from London to Brighton and back, a distance of 100 miles, in 10 hours 45 minutes running time. The riders for this trip were chosen from 60 candidates. The length of the machine is 28 feet and the gear is 51. The second person steers this machine and the others simply propel the combination vehicle.

Two "Sociables" connected in tandem.



A party of blind students off for a trip on a twelve-seated multicycle.

A Chapel on a Motor Truck

CHAPELS on wagons, on railroad coaches, on boats—we have heard of all of these; but a motor chapel—this is something new. Motor chapel St. Peter, it is called, and it was presented to the Catholic Church Extension Society by a member of a western branch of the Woman's Auxiliary. It will be used to penetrate sparsely settled regions that are beyond the reach of the railroad. Starting from Brownsville, Texas, the chapel, in charge of two priests, will work its way along the Rio Grande River westward through the State.

Mounted on a standard two-ton motor truck chassis, is all the necessary religious equipment. When the car is *en route* its somber gray finish, the eight cathedral windows with a cross design in the center of each, and the coat of arms of the society will distinguish it from commercial vehicles and give to it an appearance of individuality. When the car stops at a place for services, the rear door and hinged panels at the side open out and a drop platform is spread down, giving approximately double the floor space, thus forming a sanctuary of ample size. In the center of the platform extension is set a quartered oak combination altar and vestment cabinet with its ornamental brass accessories. Along the outer edge of the platform brass standards are fitted and provided with heavy silk cord guards. The floor of the platform is covered with a deep green Brussels carpet, and a green draped curtain hangs from the platform to the ground. To the right of the altar in one of the photographs may be seen a small folding organ, while in the foreground is a rack fitted with large tubular bells for outside use and a small chime for use at the altar. The equipment also includes a stereopticon, the power for the lantern being supplied by an electric lighting system, with which the car is completely provided. As a shelter from rain or the heat of the sun, a 20 by 50-foot gable roof tent with 7½-foot walls is furnished. When not in use, this is folded up and carried on the roof of the car.

Living quarters for two priests are provided in the forward end of the car. When the altar is not in use it is pushed to the extreme rear of the car, giving plenty of room for living quarters. In this forward space are contained lockers for personal effects, lockers for folding cots, bedclothes, drawers for books, stationery, a typewriter, cooking utensils, tableware, and a light supply of provisions. As many as three cots can be erected in berth style, suspended by means of brass chains, so that the priests and a chauffeur may be accommodated. In addition to this there are two extra army folding cots for use, when desired, outside of the car.

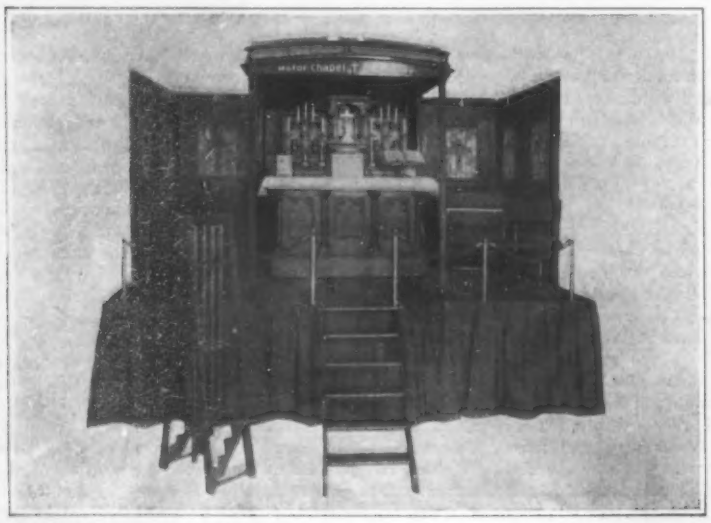
The Good Roads Movement

THAT there are upward of $400,000,000 of good roads bonds issued and outstanding is indicated by the Goods Roads Year Book of the United States, the 1913 edition of which has just been issued, containing a *résumé* of the whole road situation. It is evident that whatever may be the faults in methods of construction and maintenance, money is being spent in sufficient amount to bring about a vast improvement in the public roads. The Year Book shows $137,000,000 of State and road bonds authorized, and $156,500,000 of county bonds outstanding on January 1st, 1913, making a total of $293,500,000. As this is based on reports from about 75 per cent of the counties in the United States, and as a large number of the individual townships have not reported, it is estimated that the amounts not reported would run the aggregate up to probably $350,000,000, to which should be added ten or fifteen million dollars of the bonds voted in 1912, which have not yet been issued.

Gratifying progress in road construction during the past few years is indicated by the statement in the Year Book that while the percentage of all road improvement in the United States at the close of 1909 was 8.66 per cent, the revised statistics to December 31st, 1911, show an improved mileage of 10.1 per cent, or a net gain of 1.44 per cent. This does not sound so impressive in terms of percentage, but it means that in the two-year period more than 34,000 miles of improved roads were constructed, or 10,000 miles more than the entire mileage of national roads in France.

The Ghent Food Congress

AT the Ghent international exposition which opens in April there will be held a Congress of food adulteration and like subjects. An interesting feature is a section where will be exhibited natural products in raw and purified state along with imitations or different kinds of adulterations. Model laboratories where food products are manipulated will also be seen by the public. Numerous lectures illustrated with lantern or moving picture projections, form another attractive feature.



The chapel open and ready for service.

Motor chapel St. Peter as it appears on the road.

Premature Explosion of Shells in Three-inch Field Guns

PICTURED herewith is a three-inch gun of the field artillery of the United States Army, which exploded when being fired during target practice near Tobyhanna, Pa., on last October 4th. This gun was made of high carbon steel, of which material most of the field guns of our service are made, and was of the built-up high-power variety, the principal parts of which consist of a tube, jacket, locking hoop and clip.

These guns have a total length of 87.8 inches and weigh about 800 pounds. They fire a 15-pound shell and have a muzzle velocity of 1,700 feet per second, a maximum range of 6,500 yards, or about three and seven tenths miles, and are designed to stand a maximum pressure of 33,000 pounds to the square inch.

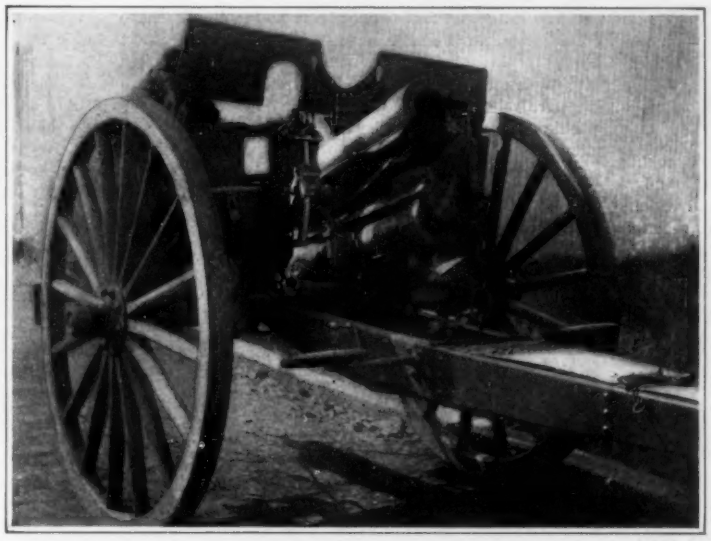
Fortunately none of the officers or men attached to the battery was killed by the bursting of this gun and none seriously hurt, which is but another of the mysteries often accompanying the exploding of ordnance, for the gunner whose seat is on the left of the breech and directly under the rupture had just left his seat and sustained only slight injury from flying splinters. No. 1 man of the gun crew, whose seat is on the right of the breech, was in that position and escaped unhurt.

At the time of the explosion the gun was loaded with a high explosive shell, containing what is known as "D" powder, and was backed by the usual charge of approximately 24 ounces of nitrocellulose powder.

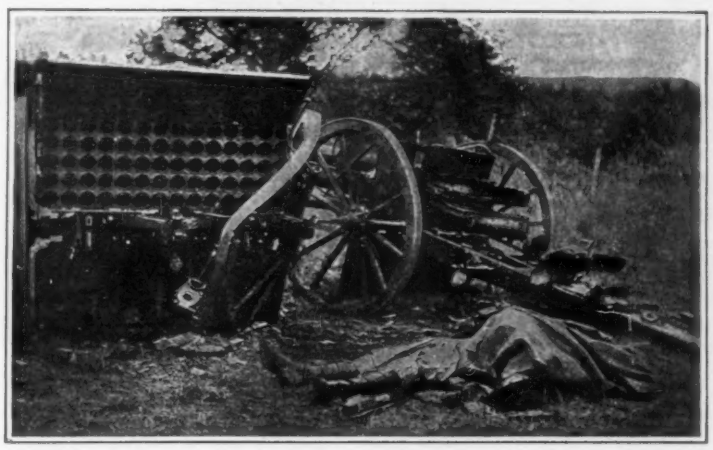
When the gun was fired the breech block was blown 90 feet to the rear (barely missing a soldier who was holding a horse) and the whole of the rear body of the gun was blown open on the left underneath for a distance of about three feet. When examined after the explosion the forward or point end of the shell was found to be in the bore of the gun, near the muzzle, and a piece of the base was jammed at a decided angle in the bore about 50 inches from the breech.

Another more serious explosion is also illustrated herewith. It took place during the practice of the Wisconsin Militia two years ago, and it resulted in the death of the gunner.

It is hard to decide definitely the cause of these explosions, several of which have occurred in the firing of 3-inch field guns, and with varying results. One thing however is clearly defined, whether such explosions are accompanied by loss of life or not—expensive and valuable property, a character of which we possess far too little, is totally destroyed. The most recent models of these guns are built of nickel steel, and to test their ability to stand the shock of premature shell explosion they have been subjected to a practical test, by the exploding of a shell in the gun chamber and with the gratifying result that the gun built of nickel steel is capable of standing the great strain without rupture. Our field artillery is inadequate, and our nickel steel guns too few.



Three-inch gun burst by premature explosion of a shell.



An explosion that resulted fatally.

Dogs for the Dutch Army

By W. J. L. Kiehl

DURING the military maneuvers last summer it often happened that the *mitrailleur*—a quick-firing machine gun for the infantry—arrived too late at the point of destination.

This deficiency was caused by the difficulty of transport; for the gun with support weighs 175 pounds, the gun being 42 pounds and the support 133 pounds. This is a heavy load for men to carry, combined or separate. To remedy the difficulty the Dutch army authorities are now making experiments with the invention of a Belgian officer, i. e., a very light cart drawn by two strong dogs. This device has already been adopted by the Belgian army for the transport of infantry *mitrailleurs* and has been found eminently satisfactory—even more so than the transport by horses of this same kind of guns for the artillery.

The very light cart, whose construction can be plainly seen in the photograph, weighs 220 pounds. Dogs and cart can very easily jump across any obstacle in the way, and the gun can be placed in position by two men. The same kind of carts and dogs are used to transport the ammunition.

The way the dogs are harnessed is plainly shown in the picture. So proud are the dogs of their task and so faithful, that none other than the men of the company to which they belong will dare to touch the gun.

Dog-drawn artillery of the Dutch army.

The Coking of Coal at Low Temperatures

IN a series of experiments carried out several years ago by Parr and Francis at the University of Illinois it was found that by coking coal at a comparatively low temperature, say 700 deg. Fahr. or less, the heavy hydrocarbons—those chiefly responsible for the formation of smoke—could be driven off, yielding a gas of high illuminating power and a tar with a high percentage of volatile oil. The solid residue in the still, however, was too friable to be adapted for ordinary use as a fuel. At the same time it was observed that an important rôle was played by small amounts of oxygen in the gases surrounding the heated mass of coal.

More recently this line of investigation has been followed out further by Prof. S. W. Parr in collaboration with H. L. Olin. They find that under suitable conditions it appears to be feasible to prepare from Illinois coals, by coking at low temperatures, a coke satisfying all ordinary requirements as regards texture and firmness. We say "under suitable conditions"—for it appears to be essential to maintain an oxygen-free atmosphere around the coal during the process. This was accomplished in the experiments of Parr and Olin by heating by means of steam introduced directly into the retort. At the temperatures employed there was no chemical action between the coal and the steam.

The authors conclude from their observations that "the fusible substance of Illinois coals is the true binding material in the coking process; that it is present in such abundance as to produce a coke of too open and spongy a character as a result of the evolution of the large amount of gaseous products which result from its decomposition. In this respect, it is paralleled by the behavior of sugar in the process of coking, which yields as a result of the large volume of escaping gases a very porous mass of sugar-coke or carbon. However, if the raw coal is mixed with a considerable amount of material which has already gone through the coking process, or which has at least given off the larger part of its gases, and then has been reduced to a fine division like breeze, the cementing material of the fresh coal is able to disseminate throughout the mass, and the gases may also escape without blowing it into a spongy mass, with the result that a coke of good texture is formed. Exactly in a similar way, if molasses or other sucrose or glucose material be substituted for the fresh coal, we shall have again the formation of a dense coke capable of retaining its shape under conditions of firing much better than where a plastic binder is used. In both cases a strongly cohering mass is produced which meets the requirements of handling, storage, and combustion with the greatest efficiency and the least formation of smoke. A small admixture of raw coal may thus be made to serve the purpose of a binder for material otherwise wasted as coke breeze, at a cost which would enable it to compete with the pitch binders now in use. This suggests a process of fractional coking, or coking in two stages. The first result at the lower temperature furnishes a product which, when ground to a moderate degree of fineness and mixed with a small portion of fresh raw coal, would furnish the essential conditions for producing a coke of dense nature with a binder so distributed as to give the material a strength quite comparable with that produced by coals of the regular coking variety. Moreover, an advantage would be evident in such material, especially for use in household appliances, in that it would be more lively in combustion and less difficult of manipulation in the matter of maintaining a fire than coke made by the usual methods."

For further information regarding this important investigation the reader must be referred to our current SUPPLEMENT.

We shall here only add a brief reference to the work of another investigator, Dr. F. R. Bergius, who has shown that by working under pressure and at a moderate temperature we can accomplish in the brief space of a few hours a result closely analogous to that produced by nature in a long time. He heated cellulose at 350 degrees in water in a closed electrically heated furnace until the pressure became 400 atmospheres. Samples were taken from time to time and it was found that the cellulose had been changed to peat. The result was obtained in twenty-four hours, no further change being obtained in sixty hours.

By applying the Van't Hoff-Nernst law of reaction velocity, it is found that the same change from cellulose to peat at 10 deg. Cent. requires 7,000,000 years—a geological period.

Discovery of the Infantile Paralysis Germ

By Genevieve Grandcourt

THOUGH at present we are unable to stop the ravages of infantile paralysis, the recent discovery of the germ responsible for it is a long step in that direction.

It is now nearly three quarters of a century since Heine, a German physician, made clinical observations of a character which established acute poliomyelitis (infantile paralysis) as a disease of a distinct character. Twenty-nine years ago Strümpell first broached the theory that this, in common with certain other paralytic seizures, is due to the presence of a germ.

From the time of the recognition of infantile paralysis as such, about fifty epidemics have been brought to the attention of physicians for systematic study. The one which prevailed in Sweden in 1890, and which furnished valuable data for extended research, seemed the starting-point for an annual recurrence. By turns in France, Italy, Germany, and the United States, human beings—principally very young children—have gone down in numbers before its blight. And in 1905, Wickman laid emphasis upon what has proved to be a most important fact, that those cases of infantile paralysis which never fully develop in certain people, play a large part in the spread of the disease.

In order to understand this, differences in the nature of resistance in individuals must be taken into account, thus: A child of three years is taken sick with headache and fever. Three days later, entirely without warning, paralysis creeps up the legs, ascends to the arms, and after an interval of possibly five days, interferes with the heart-action and causes death.

Another child, in close association with the fatal case, may have practically the same symptoms, but may never develop paralysis, being an example of the abortive type which is not the less to be reckoned with when public danger from the disease is considered.

Obstacles in diagnosing the illness were for a time insurmountable, not only because paralysis came on after a preliminary illness so slight as scarcely to afford warning of the need for a doctor, but because after the patient apparently recovered, he became, sometimes within a few days, suddenly and hopelessly crippled.

The presence of infantile paralysis came to be recognized at autopsy by scars along the spinal tract, not to be found in other parts of the body. Though functional changes in organs were effected, the nervous origin of the trouble was manifestly to be investigated as the furnisher of symptoms. When paralysis was coming on, the limbs of one side of the body would be a drag on those of the opposite side, the weight resulting in fatigue.

Though adults suffered from the disease, the largest known proportion was about one fifth of those stricken in the course of an epidemic; the favorite victims being children in their third year. In country districts, the disease seemed to radiate from the public school. The carrying agent was believed to be always the human being; no animal suffering from a form of paralysis that could be studied as co-related to it.

Some years ago, Landsteiner of Vienna confirmed Strümpell's theory of an infectious agent by transmitting the disease to monkeys. This made it possible to study the disease objectively by a new method; and since that time scientists have been giving it great attention.

Though the infantile paralysis virus does not flourish with equal facility in all individuals, it is hard to kill. Its presence in the brain, spinal cord and tonsils of recently dead human beings and monkeys has been shown by inoculation, for example, of material obtained from the nasal passages of monkeys. Moreover, experiments show that the germ does not die of prolonged heating or freezing unless excessive.

Much of the important work along these lines has been done at the Rockefeller Institute under the direction of Dr. Flexner. Experiments on animals afforded the hint that the infection may be carried from and to the mucous membrane of the nose by loud speaking, coughing, sneezing, etc.*

It is now supposed that the virus enters the body through the nasal passages and is carried by the lymphatics along the route of the olfactory nerve to the membranes that envelop the brain and spinal cord. Whether intermediate agents, such as flies and other domestic insects, play a part in the transmission, is not yet definitely established.

Flexner's work for a long time dealt with prevention and alleviation. During the summer of 1911 a large number of patients suffering from this disease were admitted to the Rockefeller Hospital, while a still greater number were treated in the clinic.

Meantime, work was going on in the bacteriological department of the Institute which was destined to have great bearing on this particular study.

A year ago, Hideyo Noguchi, the Japanese scientist at the Rockefeller, succeeded in growing for the first time the *spirochæta pallida* (the germ of syphilis). This germ was first discovered by Schaudinn in Germany, and was later developed in animals at the Pasteur Institute in Paris by Drs. Levaditi and Besredka.

Noguchi's success in developing it was due to very special research on which he had been engaged for some time with reference to the culture of anærobic germs, i. e., germs that cannot be grown in the presence of air. And Dr. Flexner suggested, not long since, that he apply these brilliant new methods to the problem of growing the hitherto undiscovered germ of infantile paralysis.

This germ appeared to be one of the so-called "ultramicroscopic" variety, that is to say, a virus so minute as to be invisible through the magnifying-glass and to pass through the pores of porcelain (Berkfeld) filters.

Acting on Dr. Flexner's suggestion, and enforcing the very strictest conditions of air exclusion, Dr. Noguchi has grown the germ of this frightful malady from the brains and spinal cords of children who have died of it; grown them in human serum kept in long, deep tubes. On the top of the serum is a layer of paraffine to keep out the air; and the germs grow only in the very bottom of the tubes in the position most distant from the air.

In the light of this scientific feat, these germs appear to be not truly ultra-microscopic, in spite of the fact that they are small enough to pass through the Berkfeld filters. They can be seen through the microscope as exceedingly tiny granules or globular bodies, in a variety of arrangements; growing singly, doubly, in short chains or in masses. They can be stained a reddish-violet with the well-known Giemsa stain by means of which the syphilis germ was first identified.

As a guarantee of the genuineness of this discovery, the crucial test proposed by Koch of Germany has already been successfully applied. This test has been applied in order to establish whether the newly discovered germ is really the cause of the disease under investigation. Germs which have been cultivated through several generations have given the experimental disease of infantile paralysis to monkeys. Then they have been recovered again from the bodies of these animals, precisely as in cases which have been so constantly under observation in the past.

It is needless to say that this discovery is of the very greatest importance in the diagnosing and treatment of cases, and that it justifies the expectation that the day is not far distant when science shall have this devastating disease under relatively perfect control.

* Rock. Inst. Reprints, vol. xvi, p. 1.

Lightning Calculations

Extracting Roots of Numbers by Inspection

By Alfred J. Lotka

AT a recent meeting of the Société Française de Philosophie, M. Quinton astonished the members present by extracting cube roots and fifth roots of given numbers at sight. The matter has received considerable discussion in the daily newspapers, but for some reason the method employed has not gained very general publicity, nor has the *rationale* of the process been exposed. I shall first of all describe the method as reported in *Le Matin* and *La Nature*, and shall then show how the rules given follow from simple mathematical considerations.

It should be remarked at the outset that the method, as described in the sources quoted, applies only to perfect cubes, and, generally, to odd powers of whole numbers. A few examples will best serve to explain it.

As regards fifth roots, M. Quinton observes that the last digit of the fifth power of a whole number is always the same as the last digit of the number itself. Thus, $1^5 = 1$; $2^5 = 32$; $3^5 = 213$; $4^5 = 1{,}024$; $5^5 = 3{,}125$; $6^5 = 7{,}776$; $7^5 = 16{,}807$; $8^5 = 32{,}768$; $9^5 = 59{,}049$. Hence, if given the fifth power of any of the numbers 1 to 9, and asked to extract the fifth root, we can do so instantly by inspection of the last digit. If the number given exceeds 9^5 the process is a little more complicated. It becomes necessary to memorize the fifth power of the first nine digits, as given above. An example will best illustrate the method. It is required to find the fifth root of 229,345,007, this number being the fifth power of a whole number. The last digit of the root sought will, as before, be 7. To find the other digit, inspect the digits of 229,345,007 which precede the tens of thousands and do not exceed ten billions (ten thousand millions). In the present case they are 2,293. Now 2,293 falls between 4^5 and 5^5, as will be seen by referring to our list of fifth powers above. Then the last digit but one of the number sought is 4, and the entire number is 47, as the reader may convince himself by trial.

For cube roots the method is slightly different. M. Quinton observes that the cubes of 1, 4, 5, 6, 9 end in 1, 4, 5, 6, 9; while the cubes of 2, 3, 7, 8 end in 8, 7, 3, 2, i. e., in numbers found by subtracting 2, 3, 7, 8 from 10. The cube roots of numbers less than 1,000 are therefore obtained by inspection of the last figure as follows: $\sqrt[3]{8} = 10 - 8 = 2$; $\sqrt[3]{27} = 10 - 7 = 3$; $\sqrt[3]{64} = 4$; . . . $\sqrt[3]{729} = 9$. For cube roots of the higher numbers we must memorize the cubes of the numbers between 1 and 9. Thus $\sqrt[3]{5{,}832} = 18$, for $(10 - 2) = 8$ and 5 lies between 1 and 8 and therefore has a root lying between 1 and 2. The digit in the tens is therefore 1, and the number sought is 18, as stated.

M. Quinton has similar rules for extracting the 7th, 9th, 11th roots, etc.

Now let us see how we can account for these remarkable facts:

Let us consider the case of the fifth root. We want to show that the last digit of x^5 is x. This is the same thing as saying that the last digit of $(x^5 - x)$ is zero, or that $(x^5 - x)$ is divisible by 10. Now $(x^5 - x) = x(x^2 + 1)\ (x + 1)\ (x - 1)$.

It is immediately obvious that if x itself is divisible by 10, then $(x^5 - x)$, since it contains the factor x, will also be divisible by 10. Furthermore, if the last digit of x is 1, then $(x - 1)$ is divisible by 10. But $(x - 1)$ is a factor of $(x^5 - x)$, which is therefore also divisible by 10. Similarly if the last digit of x is 9, then $(x + 1)$ ends in zero, and so does therefore $(x^5 - x)$.

Now if x ends in 2, then x^2 ends in 4, and $(x^2 + 1)$ in 5. Hence $(x^5 - x)$ contains the factors 2 and 5, i. e., its last digit is again 0. Again, if x ends in 3, x^2 ends in 9, and $(x^2 + 1)$ in 0. Thus $(x^5 - x)$ ends in 0. If x ends in 4, $(x + 1)$ ends in 5 and $(x^5 - x)$ contains the factors 5 and 4, that is to say, it ends in 0. If x ends in 5, $(x + 1)$ is an even number, and hence $(x^5 - x)$ contains the factor 10. If x ends in 6, $(x - 1)$ ends in 5. If x ends in 7, $(x^2 + 1)$ ends in 0. If x ends in 8, $(x^2 + 1)$ ends in 5 and $(x^5 - x)$ contains the factors 2 and 5. Our proposition is therefore proved.

The *rationale* of the rule for numbers greater than 9 is so obvious as to require no explanation. The rules for the third, seventh and other powers can be explained by a similar process, which I may leave to the reader to work out. I will only add that $(x^5 - x)$ is divisible not only by 10, but also by 3, as the reader may show either by inspection of the fifth powers cited above, or by a process of reasoning similar to that developed here.

The Current Supplement

MR. FRAASA'S article on the construction of a self-starting induction motor is concluded in this week's issue of the SUPPLEMENT.—Mr. R. H. Rogers tells us "why our freight traffic costs us five times as much as national, State and local taxes combined."—The musicians among our readers will be interested in the illustrated description of a typewriter which prints music characters.—V. Jefferson Watts contributes an article on Knowledge and Morals, which is referred to more at length on our editorial page.—E. V. Huntington gives a simple formula for computing gyroscopic forces in aeroplanes.—A highly efficient photo-mechanical process for preparing illustrations, which has found extensive applications and promises still further development in the future, is described.—Prof. J. J. Thomson continues his discourses on "The Structure of the Atom."—A. Whitehead discusses some indirect causes of imperfect interchangeability of machine parts.—Prof. S. W. Parr of the University of Illinois, collaborating with H. L. Olin, has conducted important researches on the coking of coal at low temperatures. A detailed extract of their report appears in this issue of the SUPPLEMENT.—E. F. Bashford discusses the relation of certain cases of cancer to the presence of parasitic worms in the body of the animal afflicted.

A New Method for Cooling Mines

A GERMAN engineer, M. Dietz, proposes a method for cooling the air in mines, which will overcome the existing difficulties. The temperature in mines, which increases with the depth of working, makes it necessary to fix a maximum number of hours per day for the miners, and in the German mines where the temperature often exceeds 28 deg. Cent. the men do not work more than 6 hours per turn. Such conditions cause a greater expense for labor and a lessening of the yield, and the present method is intended to keep the temperature below 28 degrees at the working points so as to allow of a continuous working as in other industries. After showing the reasons why previous attempts in this direction were not successful, he exposes his method, which is to compress air at the surface of the ground and then put it through a drying process. The compressed air then goes into an expansion apparatus or air turbine, where it expands and furnishes work to this machine. The air also becomes cold by the effect of the expansion on the well-known principle, and it is then taken by means of a protected piping into the mine and delivered at the proper point so as to secure a good ventilation and a cooling of the air within the mine. In this way he claims that the mine can be cooled more effectively than heretofore.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Inventors and Their Needs

To the Editor of the SCIENTIFIC AMERICAN:

You render invaluable service toward advancement by publishing the letter of Mr. Kennedy in your issue of March 29th. The subject surely demands serious action.

The inventor, as a rule, is not "money-wise"; his vocation is to serve humanity, and he should not be deprived of reasonable compensation nor permitted to fall into the trap of the mercenary. Many lose through indiscreet confidence in the personal representative of capital. I happen to know through experience. There may be a law to protect ideas, but the inventor has no money to go to law when called upon to defend himself.

I am now working upon ideas pertaining to a rotary gasoline engine, also a device for launching lifeboats in heavy seas and a life-saving device for use in the tall buildings when fire escapes, ladders, and all other means fail. It is remarkable that the last is not already in general use, but it is not, and as usual the device is of quite simple construction and of genuine merit.

You should reprint Mr. Kennedy's letter.

Cincinnati, O. HOWARD SMITH.

The Falling Elevator

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to an error in the issue of SCIENTIFIC AMERICAN of March 8th. On page 233 you say: "It is interesting to note that as the falling distance is four times the stopping interval, Mr Ellithorpe will, during the latter interval, have his weight increased fourfold. Such is not the case. His weight will be increased fivefold.

Suppose the falling interval is 400 feet and the stopping interval 100 feet. Suppose a man weighs 100 pounds Work done by gravity on man in total descent =100 (400+100)=50,000 foot pounds. This must be absorbed in the latter interval of 100 feet. Hence pressure of man on elevator=50,000 foot pounds divided by 100 feet=500 pounds. If the man's weight is 150 pounds he will "weigh," during the stopping period, 750 pounds.

This is supposing the stopping acceleration to be uniform, which of course it can not be, for if his pressure were to change from 0 on the elevator to 750 pounds suddenly, he would collapse. Hence, as you point out, the negative acceleration must increase gradually. This will make the pressure of a 150-pound man much more than 750 pounds during the latter portion of the stopping period J. S. COON.

Atlanta, Ga.

The Mississippi Problem

To the Editor of the SCIENTIFIC AMERICAN:

I saw some articles in your paper discussing methods of improving the Mississippi River. There is one fact about the Mississippi to which you do not seem to attach any importance, and that is, it is a silt-bearing stream, which should not be left out in any plan for the control of the river. It is, as you say, not practical to regulate the quantity of water in the river by retaining in reservoirs, in the upper sections of the river, enough water to prevent overflows in the lower sections. Every inch in the rise of the river increases its carrying capacity, not so much because of the volume added to the mass of the water, but because of the increased speed of the current. I saw observations made by an engineer at New Orleans which showed that at high water, a rise of twelve inches doubles the quantity of water passing at New Orleans. As a difference of no more than one foot at New Orleans would not have been sufficient to prevent the river from overflowing in 1912, reservoirs having the capacity of preventing the river from overflowing in that year should have been extensive enough to retain considerably more than one half the water that drained into the river, and this would require the condemning of a territory larger than several States. It is clear enough that the capacity of the river to carry water must be increased, and that levees do increase this capacity; but it is not clear that levees are the only means which can increase the water-carrying power of the river. The effect of levees is to increase the thickness or depth of the water; the measure of the increase is from the level of the land on the banks of the river to the top of the levee; if there were no levee, the same thickness or depth of water would be secured by removing the required number of feet of earth from the bottom of the river. Nor is it certain that it is absolutely necessary that so much water should be wasted every year.

If a State must use its own means only to protect itself from the river, it is clear that it must build levees, there is nothing else it can do; but the boundaries of the Union include the entire length of the river and its tributaries. The only manner in which money can be profitably expended by one State in controlling the river, is by building levees; but with the general Government, the case is very different.

The general Government can utilize the natural law which governs the amount of sediment water holds in suspension depending upon the motion of the water and on the velocity of that motion. If a given amount of earth be placed in the bottom of a vessel containing clear water, and the water be quite still, it will remain clear; none of the earth will rise into the water, all will remain in the bottom of the vessel. If then the water be stirred and made to acquire a motion, it will take from the bottom and hold in suspension an amount of earth proportioned to the velocity of the motion; the amount of earth in the bottom of the vessel will be decreased and the depth of water will be increased. If water resting on earth be perfectly still, it will become clear, but if the water acquire motion, however slow, it will contain sediment. Since the amount of sediment water will hold in suspension is in proportion to the velocity of the motion of the water, in order to deepen a silt bearing stream, it would be necessary either to increase the velocity of the current, without increasing the amount of silt draining into the stream, or to diminish the amount of silt draining into the stream without diminishing the velocity of the current.

Surface drainage of rain water carries with it quantities of the earth over which it passes. Such water having all the sediment it can carry possesses no scouring power, it cannot deepen a stream; it may even cause a stream to shoal if the current be checked, as, for instance, by the work at the Southwest pass.

Much of the sediment in the Mississippi comes from the Missouri. If the land which furnishes the mud to the Missouri were tile drained, this water would be clear. While the Missouri would be deepening it would continue to discharge much sediment in the Mississippi, and this river would not deepen at once, but when the Missouri would have deepened sufficiently so that its current would have become slower, its water would become comparatively clear, and this water coming into the Mississippi as clear water instead of as muddy water, would diminish the total quantity of sediment in the Mississippi, and this river would deepen in consequence. I mention the Missouri because of the quantity of mud it discharges, but the Ohio should not be overlooked, since this is the river which furnishes the water which floods the lower Mississippi.

The quantity of water coming from the Missouri compared to the territory which it drains would seem to indicate that the rainfall in that territory is not sufficient. If this territory were tile drained by tiles located below the hard pan, all that portion of land between the tiles and the surface would become more or less porous and would retain moisture to increase the yield of the land.

Deepening the river by means of diminishing the quantity of sediment in its water would deepen the channel at the mouth for ocean-going vessels.

There is a manner in which the deepening of the river would bring in returns enough to repay many times over any sums that might be expended. There are quantities of land, extending in some places more than a hundred miles in width from the Mississippi, which, from having been covered by the floods of the river for generations, have become elevated by the silt deposited on them. These lands cannot drain naturally into the river at high water. As more silt was deposited near the source of supply than at a greater distance, the lowlands along the river have a gradual slope to the Gulf; so that by building levees which prevent the river from directly overflowing land behind the levees, this permits the draining of these lands into the Mississippi at points below. Above Red River, land on the Mississippi can not drain directly into the Gulf, but must return into the river. If the river were deepened so that at the highest point it could reach it would still be as little as ten feet below the highest point it reaches now, it would be difficult to estimate the gain that would result.

Thibodaux, La. JULES LAFOREST.

A Plea for the Patentee

To the Editor of the SCIENTIFIC AMERICAN:

Were all improvement to cease with the present day, all inventions to end, then an unjust, iniquitous law that would deprive the inventor of his well-earned "monopoly" might be passed with impunity; for it would only rob one class of people, the inventors, the men of progress, those men who have made the world better, living cheaper, conveniences greater.

But will men of brains, men of genius, men of inventive talent, spend months and years of study and labor constructing, improving, creating some new machine for the use of mankind, some valuable process by which commodities are cheapened for the use of the many, when the patent laws will not guarantee them at least the pecuniary patronage as the result of years of disheartening labor? I speak from experience as well as from observation. There are hundreds of inventions to-day that have never been patented by their inventors, some to my own knowledge of great value; inventions that rightfully remain undisclosed to the public. And why! Why? Because the public says: "We will take your invention and give you no just recompense for your years of study and labor." And the inventor replies to the public: "Keep your money, and I will keep my invention." The pressure of ignorant opinion might cause the enactment of less effective patent laws; but neither the public nor the law can compel the inventor to disclose his invention. And who is the greater loser? The inventor, who must needs get his livelihood by means other than invention, or the great public, which never benefits by some improvement, some commodity, which never even knows what benefit it has deprived itself of?

I say the patent laws are not strong enough. We should have a patent law that would make it *the duty of the Government* to prevent infringements of patents without putting that burden upon the inventor. And we should have negotiated between the nations *a universal patent law*, whereby a patent might be taken out (at an additional not prohibitive cost) to cover all countries.

Washington, D. C. WILLIAM EDWIN EMORY.

Certain Unrecognized "Patent Rights"

To the Editor of the SCIENTIFIC AMERICAN:

Many inventions are produced almost simultaneously by parties having no knowledge of the other's doing; in which case the "second" inventor fares rather poorly under the present patent system. In an interference suit the Patent Office awards priority of invention to one party, and will grant patents on their specific details to the other contestants, who will be subject to the broad patent. This can hardly be otherwise. But in many cases has not the second inventor vested rights?

Most inventions of merit are worked out practically, often at great expense, and frequently marketed before a patent application is filed. When two or more inventors independently demonstrate equivalent inventions about the same time, they may both be said to advance the art substantially equally. In such a case, if the losing party in an interference shows that he would suffer by prohibition of the use or sale of his invention, should he not be allowed a license, secured by compulsion if necessary, under the master patent?

Probably in the future, inventions most beneficial to the community will be the result of careful scientific development. Instead of being so much the work and thought of one person, an industrial advancement will evolve from experiment and elimination conducted by men in collaboration. The industrial and experimental laboratories of corporations, colleges and scientists will no doubt contribute most toward industrial progress.

If several well-equipped organizations are scientifically working to improve similar products, supply the same public demand, or open a new field, they will in many instances obtain substantially equivalent results. In such case there will need to be provision that a technically second inventor be not deprived of his invention to his financial loss.

One of the risks in developing an invention is that someone else may be first and by a controlling patent absolutely prevent its use. The master patent may even issue subsequently to the patent dominated, provided it was filed before or within two years of such patent.

The parties adversely affected have no redress, but could receive equitable treatment by means of a compulsory license granted on reasonable terms. Would this not remove a certain speculative feature from the field of industrial development and make it a sounder business undertaking?

Another feature is that an inventor of a revolutionary improvement may find his progress blocked unless he can secure license to use other inventions, as was Bessemer by Mushet. (Note SCIENTIFIC AMERICAN SUPPLEMENT, December 28th, 1912.) A logical or almost obvious improvement may be patented to someone else who endeavors to exact undue tribute, for the patent law makes no distinction between originative and intensive invention or those of much or little potential value to the country's industries.

Reverting to the evolution of inventions by the collaborative work of employees of corporate bodies, can we not say that an incorporated company invents? It cannot only buy and sell goods, but traffic in intangible things, as good will, franchises, licenses, and so forth. Probably many patentable improvements are not the invention of one person or the joint invention of several, but the industrial evolution produced by experimentation of scientists, engineers and mechanics in the employ of an incorporated body. The patent law does not recognize such corporate inventing, and of course if it did should carefully protect independent inventors.

Ottawa, Canada. F. D. WITHROW.

Brucker's Balloon Trip Across the Ocean

By Our Berlin Correspondent

THE daily press recently published a notice that the scheme for the transatlantic balloon expedition originated by Joseph Brucker, at the beginning of 1910, had been abandoned. Dissensions among the members of the expedition (Mr. Brucker, Dr. von Gans, Capt. Jördens and Dr. Alt) were said to be responsible for the fact that the original plan of crossing the ocean with a dirigible, though with the aid of trade winds, had to be given up. However, some of the members were so greatly attached to the idea that Joseph Brucker made up his mind during the present spring to try the passage single-handed by means of a spherical balloon from the Canary Islands.

The balloon destined for this transatlantic trip was constructed and equipped in the relatively short time of six weeks, and on February 28th performed a trial flight attended by representatives of the Bavarian military authorities. The balloon, 7,250 cubic meters in capacity, ascended on the stroke of 12:30, and after reaching in a short time a height of 2,350 meters, sailed between two thick cloud strata toward the Inn Valley, landing at 3 o'clock in the Chiemsee district.

Special importance is attached to the sprinkling arrangement designed on plans by Mr. Brucker and Dr. Alt of the Munich Meteorological Institute. This arrangement consists of rubber hose and is intended, in the case of intense sun radiation, to sprinkle and cool the balloon with a spray of water, thus preventing any undue expansion of the gas.

After this successful trial trip, the balloon "Suchard II." was transported to Teneriffe, from which place, according to Brucker's calculations, the cross-sea trip will last six to eight days at the utmost. The basket is seaworthy and has been equipped in accordance with such a long trip.

The balloon in which Brucker hopes to cross the Atlantic.

The seaworthy basket of Brucker's balloon.

Protection of Ocean Liners by Subdivision

THE two accompanying illustrations, showing the inner skin which has been built into two notable ocean liners, one the "Olympic," already in service, the other the "Imperator," which is about to enter the transatlantic service, prove how quickly the White Star Line and the Hamburg-American Line have built into their ships the great lesson which was taught by the sinking of the "Titanic." Within a few days of the anniversary of the loss of that ship, her sister, the "Olympic," reached New York on her first voyage after six months reconstruction at the Belfast yards. At the time of the loss of the "Titanic," the SCIENTIFIC AMERICAN pointed out that the most important lesson of the disaster was not so much the shortage of lifeboats, as the fact that the "Titanic" herself was so little qualified to serve as her own lifeboat in case of serious injury, and remain afloat until her passengers could be transferred to some rescuing ship summoned by wireless. We drew attention to the fact that the "Great Eastern," launched over half a century ago, embodied in her under-water construction certain principles of sub-division which rendered her so safe a ship, that she could in all probability have passed through the ordeal which sank the ship of fifty years later date. The "Great Eastern" was built with a complete inner skin, with longitudinal bulkheads throughout the engine and boiler room spaces, and with bulkheads, both transverse and longitudinal, which were carried up through the full height of the plated structure of the ship to a level about thirty feet above the water line.

It was shown that, while warship constructors had retained and developed the features which made the "Great Eastern" a ship so difficult to sink, in the merchant marine there has been a gradual elimination of these elements, until nothing was left but the transverse bulkheads and the double bottom. We suggested that future ocean-going steamships could be rendered reasonably secure against sinking by building them with an inner skin and carrying the bulkheads to a reasonable height above the water line.

As the result of the Government investigations in this country and in England, and of the meetings of the various committees appointed to investigate the subject of sub-division, the principles to which we drew attention at that time have been broadly accepted. The White Star Company withdrew the "Olympic" from service and sent her to the Belfast yards, where alterations have been made which have cost the company about $1,500,000. These changes, which have involved the working into the structure of the ship of an additional one thousand tons of steel, are as follows:

To the original fifteen transverse bulkheads, an additional bulkhead has been added, dividing the ship into seventeen separate watertight compartments. The original height of the top of the bulkheads amidship was about ten feet above the water line. In the reconstructed ship about one half of the bulkheads have been carried up to the top plated deck at a level of about forty feet above the water line. Bulkhead No. 1 has been carried up to the forecastle deck at an elevation of about forty-five feet above the water line, and No. 2 bulkhead has been raised to C deck, one deck higher than formerly. Below the water, steel watertight flats have been built, covering the space between the stemhead and bulkhead No. 2, and forming two entirely separate watertight compartments. No. 3 bulkhead extends to E deck, No. 4 to B deck, No. 5 to E deck. No. 6 bulkhead extends to B deck, as does also bulkhead No. 10 and the new bulkhead known as No. 12A. Bulkhead 13 also is carried to B deck. No. 14 reaches E deck and No. 15 extends to D deck. The two after compartments are covered below water by watertight floats or deck near the water line. These changes more than conform to the suggestions made by the Senate committee that investigated the loss of the "Titanic."

A complete inner skin has also been built throughout the length of the boiler- and engine-room spaces, by carrying the floor of the ship up to the full height of the main frames, to which it is everywhere strongly riveted. The outer and inner skins are connected by a series of intercostal and longitudinal frames and each double side wall as thus formed between two transverse bulkheads, is divided into four separate watertight compartments by a central vertical and a central longitudinal diaphragm.

To assist in ridding the ship of water in case of injury, an eight-inch pipe which extends the whole length of the ship has been added to the drainage facilities, and it has connections which enable each tank top to be drained independently. This pipe leads to its own independent pumping plant.

Watertight electrically operated doors, all of which may be closed from the bridge, are fitted in all the extensions of the bulkheads. It should be mentioned also that in the two bulkheads which intercept the working alleyway (which latter proved a serious factor in the loss of the "Titanic") watertight doors are provided.

All of the bulkheads, old and new, and the bulkhead doors, have been greatly strengthened by riveting upon them additional heavy channels and angle irons, their strength being estimated for the maximum possible submergence of the ship.

At the time of the loss of the "Titanic," work on the construction of the "Imperator," of the Hamburg-American Line, had not progressed so far but it was possible to introduce additional subdivisions designed to protect the ship against an iceberg collision such as befell the "Titanic." The "Imperator," as at that time constructed, was provided with an inner skin, in the shape of the inner walls of the coal bunkers, which extend throughout the full length of the boiler spaces. This inner skin is situated from fifteen to eighteen feet inboard from the outer skin of the ship and, therefore, in the event of the rupture of the outer skin, say by a colliding ship, the inner wall is so far removed as to be beyond any likelihood of injury. This is the method of arranging the coal bunkers which is practised in all the navies of the world, and it gives great

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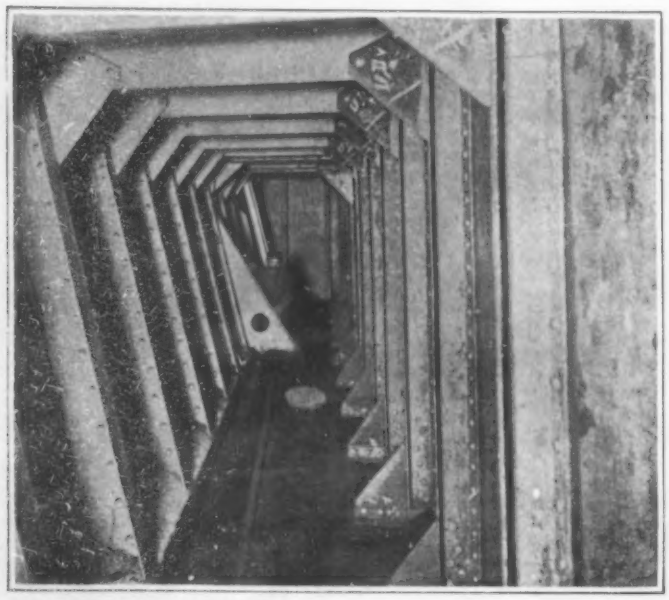
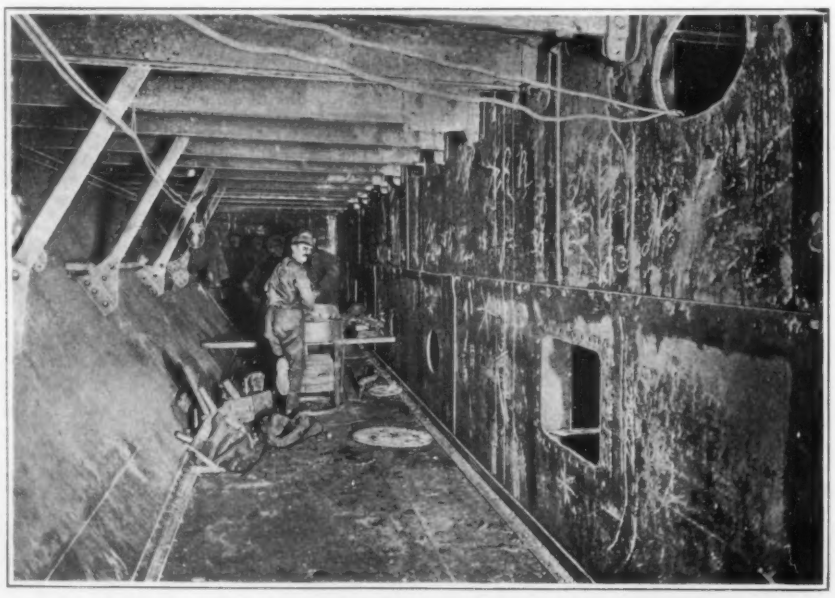


View of the space between the inner and outer skins of the "Imperator."



Building the inner skin (on the right) of the S. S. "Olympic."

Babylonian Excavations by the Germans

How Nebuchadnezzar and His People Lived

By Edgar J. Banks

THE excavations conducted by the Germans in the Mesopotamian Valley began in 1899, and are still continued. The ruins of several Babylonian cities, Abu Habba, Fara, Babylon, and of the Assyrian capital Assur, have been uncovered in a most systematic manner. The results have been meager in some of the ruins; in others, they have been of the greatest archaeological importance. The general oversight of the entire field has been in the hands of Dr. Robert Koldewey, an architect, who has personally superintended the excavations at Babylon, and who has had a large and varied career in Oriental excavation work. He has been assisted by several Assyriologists and architects; of these, Dr. Maresh, now in charge of the work at Assur, deserves great credit. The funds for the support of the excavation have been provided by the *Deutsche Orientgesellschaft;* to which the German Emperor has been a liberal contributor. This German activity in Mesopotamia far surpasses that of any other nation, which activity may be due to the fact that the German government would increase its influence in that part of the world, perhaps with the hope that when the German railroad across the northern desert to Bagdad shall have been completed, this land of mineral wealth and of ancient ruins may be practically German territory.

The First Excavations and the Result.

Abu Habba, a small ruin in central Babylonia, and Fara, a few miles farther south, were the first to attract the German excavators; the results at these two ancient sites were comparatively insignificant. At Abu Habba trenches revealed scarcely more than the walls of the houses from a middle period of Babylonian history, and the work was soon abandoned. At Fara, a low mound, half a mile in length and about half as wide, work was continued for about nine months with a force of two hundred men. Beginning at one end of the ruins, trenches about 10 feet wide and 5 feet deep and a few yards apart were dug entirely across the mound, and whenever the walls of a house appeared they were followed until the nature of the structure was revealed. The results were few. An abundance of pottery, some marble vases, vertical drains of tiles and wells only were discovered. Finally, when the system of trenches had been carried the entire length of the mound, a large palace of an exceedingly early age appeared. In the chambers were several large clay tablets covered with primitive cuneiform characters. It happened that in a fight during the work an Arab was killed, whereupon the excavations were stopped by the Turkish government. The inscriptions revealed the ancient name of the city as Shuripak, the scene of the Babylonian story of the flood which appears in the Gilgamish epic.

A valuable discovery at Fara was a large arch sewer beneath the city. Though we have long been taught that the arch was of Roman origin, the arch of this sewer was perfect and symmetrical, and from an age not far from 4500 B. C., when the pre-Semitic Sumerians occupied the land. The bricks used in its construction were plano-convex, resembling in shape and size a small loaf of bread; they were burned to a dark red. The plano-convex bricks appear to have been the first burned bricks ever employed.

Attacking the Site of Babylon.

Could the excavations have continued a few weeks longer, more remarkable discoveries might have resulted. However, the Germans then turned their attention to the ruins of Babylon on the left bank of the Euphrates, 70 miles south of Bagdad. Unlike most Babylonian cities, the site of Babylon had never been quite forgotten. Travelers of every age have described it. Nearly a century ago large square bricks bearing cuneiform inscriptions with the name of Nebuchadnezzar were taken to the British Museum, and the ruins have long been a profitable source of revenue to the Arabs who have searched among them for bricks. Hillah, a city of 10,000 people, is constructed of them. The court yards of the houses and a large city square are paved with them; they have been employed in the construction of an irrigating dam across the Euphrates, and still the supply seems inexhaustible.

The ruins of Babylon consist of three large and several small mounds. Surrounding them is a ridge of dirt, reaching in places to a considerable height, and representing the city walls. Herodotus says the walls were 335 feet high and 85 feet wide. Other writers claim that they were from 42 to 56 miles in circuit; that they were surrounded with 250 towers, and pierced with 100 gateways with gates of bronze. Though the Germans have attempted to trace the walls throughout their extent, they have but partly succeeded, yet it seems that the ancient writers were fairly accurate in their descriptions.

Of the three larger mounds, Babil, the one to the north, still retains its ancient name. Square in shape, it rises to a height of over 100 feet. Specially here have the Arabs long been digging for bricks. The Germans have paid little attention to this mound, except to examine the walls which the Arabs have uncovered. Dr. Koldewey believes that an ancient structure, which gave rise to the Biblical story of the Tower of Babel, stood there. At the base the Arab diggers have revealed the huge arches of passageways leading through the mound, and they have led some scholars to believe that they supported the famous hanging gardens of Babylon. It is supposed that the over-hanging foliage of the several terraces had the appearance of being suspended in the air.

The central of the three large mounds is the Kasr, or the fortress, so named by the Arabs, because of the massive walls which have always projected from the surface. Here the Germans have made their most remarkable discoveries. It is the custom of the Germans to employ a force of two hundred men the year around. The men are divided into gangs of twelve each. At the head of the gang is the pickman, who loosens the dirt; his pay is twenty cents a day. With him are three men with triangular hoes, who scrape the dirt into baskets; their pay is sixteen cents a day. The remaining eight men of the gang are basket men who carry the dirt from the trenches to the dump or the car; their pay is twelve cents a day. Small children are employed at the rate of four cents a day. It is only at Babylon that a narrow iron track with small push cars to carry the dirt to the edge of the mound, has ever been employed in Babylonia.

Babylon a Comparatively Modern City.

The antiquities discovered in the Kasr have not been so ancient as the Germans had hoped. Babylon is a modern city when compared with other Babylonian cities to the south. Sinacherib, King of Assyria from 705 to 681, boasts that he completely destroyed it, scraping even its foundations into the river; it is a fact that little or nothing previous to Sinacherib's time has been found. The Babylon whose ruins still exist is the city of Nebuchadnezzar; the palaces and temples the Germans have excavated were constructed by him or by later kings.

An object of interest from the Kasr was found by Arabs long before the Germans began their excavations. It is a large granite lion standing over the figure of a prostrate man. The monument was never completed, and the Arabs have mutilated it by digging deep holes into its sides in their search for hidden wealth. It bears no inscription to tell its age or history. Dr. Koldewey has erected it upon a platform of bricks, where it now stands as if to guard the ruins. The first valuable object discovered by the Germans was a black monolith, brought in ancient times as a trophy of war from the Hitite city of Karkemish. It adorns Babylon just as now Egyptian obelisks adorn New York and various European cities. The front flat side of the stone is sculptured with a Hitite warrior, holding his weapons in the air; the rounded back is covered with the undeciphered characters of the Hitite language.

The Palace of Nebuchadnezzar.

Nebuchadnezzar's palace in the Kasr may be regarded as the greatest of Dr. Koldewey's discoveries. Little but the foundations of the palace remain, and they are of square burned bricks, each of which bears on its lower face the name and title of the great king. The several hundred chambers of the palace are small; some of them are scarcely larger than a modern bed. As they were cleared out they were found to contain little of value. One chamber, much larger than the rest, had on one of its sides a low platform of bricks. This is supposed to have been the throne room, and upon the platform the throne of the king may have stood. So thorough was Dr. Koldewey in his excavations that he removed the bricks of the walls and the paving of the throne room; now only the place where they were is visible.

There was a sacred street in Babylon leading from the palace to the temple, along which the images of the gods were carried in processions, according to a religious rite. The gateway known as the Ishtar gate, leading to the street, is most imposing, and gives us a good picture of how Babylon must have looked. Fortunately it has escaped destruction at the hands of the Arab brick diggers. Whatever its original height may have been, it still stands 40 feet above the street. Its six square towers of burned bricks, measuring twelve feet each way, contain on all their sides, one above another, beautiful reliefs of bulls and lions and dragons and animals of fantastic shapes. The reliefs are of brick glazed blue and yellow and white, and the coloring is as fresh as ever it was. Each brick of the relief was shaped and glazed separately and so accurately that when it was placed in the wall it formed a part of the perfect picture. The art could scarcely be surpassed.

The most stupendous work done by the Germans has been in Amran, the southern of the three large mounds. There, forty feet beneath the surface, below the accumulations of the Arabs and Hebrews and Parthians and Persians, who have lived and built upon the site, was discovered Esagil, the famous temple of Babylon. Imagine a hole an acre or more in extent and forty feet deep, excavated entirely by hand, and you will understand the untiring patience of the Germans. Little but the foundation of the temple was found. Yet that is enough to reveal its plan, its extent, and the similarity of the Babylonian temple, with its outer and inner court, its holy of holies, its secret chambers and passageways, to the Hebrew temple.

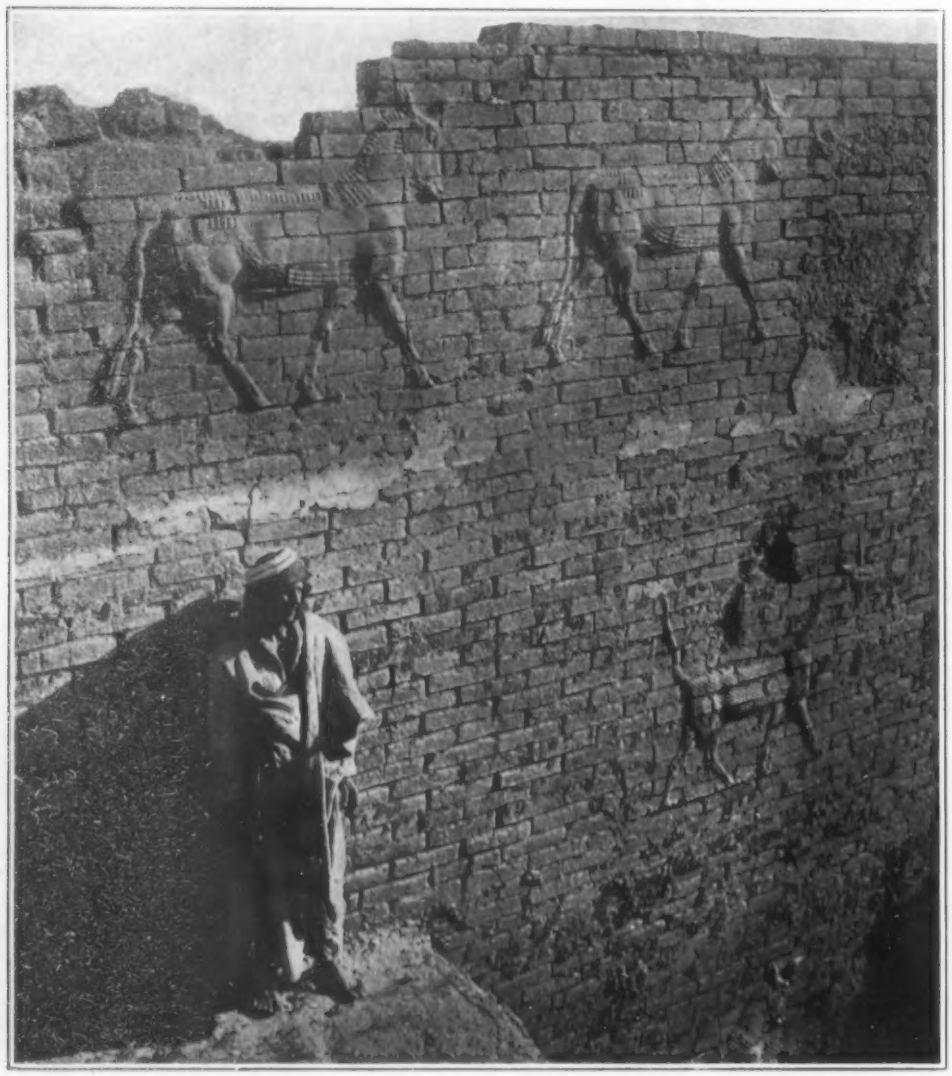
Few clay tablets have been found by the Germans at Babylon. Their smaller finds consist of Parthian coins, pottery, weights, stone implements, images, beads, jewelry and similar objects. However, in Jumjuma, one of the smaller mounds to the south, the Arabs found a large collection of clay tablets, many of which came from the Hebrew concern of the Egibi family. Egibi is the Babylonian pronunciation of the name Jacob. The tablets teach that for many generations the most influential brokerage concern of Babylon was in the hands of the Hebrew family of Jacob. Equally interesting was a clay, barrel-shaped cylinder, describing the capture of the city by Cyrus, King of Persia. The excavation of Babylon is not yet completed. Much of it still lies beneath forty or fifty feet of later ruins, and future results may be of greater value than those of the past.

The Excavations at Assur.

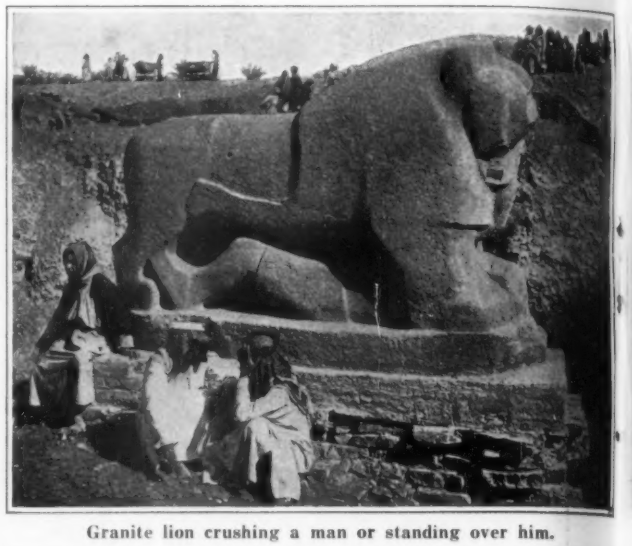
The excavations at Assur, the Assyrian ruin now called Shergat, which lies on the right shore of the Tigris, about half way between Niniveh and Bagdad, have been of the greatest importance. Work began there in 1904; it is expected that it will be completed in about two years. Assur was the first Assyrian capital city, giving its name to the Assyrian nation; there the oldest Assyrian monuments have been discovered. Assur continued as a sacred city until the fall of Niniveh in 606 B. C.

Dr. Andrae and his successor, Dr. Maresh, traced the ancient double walls of the city, and the moat, and cleared the ancient gateways. In places the parapet along the outer edge of the summit of the walls was preserved, and even the loop-holes through which the archers might shoot the enemy at its base are still perfect. Within the city were discovered the earliest Assyrian palaces and temples, the home of the mayor, with an intricate system of water works and drainage, a business street lined with shops and paved with blocks of marble, the thickly crowded residential section of the poorer people, the great vaulted tombs of the nobles, with massive doors of stone, which still swing on their stone pivots, weapons and innumerable ornaments of gold and stone. At the southern part of the city, in an open space by the walls, there appeared a veritable forest of stone monuments, monoliths from four to eight feet high, each engraved near its top with an Assyrian inscription containing the name of the king or noble to whom it was dedicated. One of them bore the name of Shamuramat, or the once supposed mythical Semiramis, who, so tradition says, was transformed into a dove. Of all the objects discovered by the Germans in Mesopotamia, this one is of the greatest historical value.

Within the past three months the Germans have gone to the south Babylonian ruin of Warka to begin their excavations in that largest of all the Babylonian mounds. There lived the hero of the Gilgamish epic, and Erech, its ancient name, is mentioned in one of the early chapters of the Bible. Should its excavation be carried on with the same patience and thoroughness with which the Germans have worked at Babylon and Assur, the world may expect discoveries of the greatest interest.



The Ishtar Triumphal Gate. Upon it appears a bull ornament.



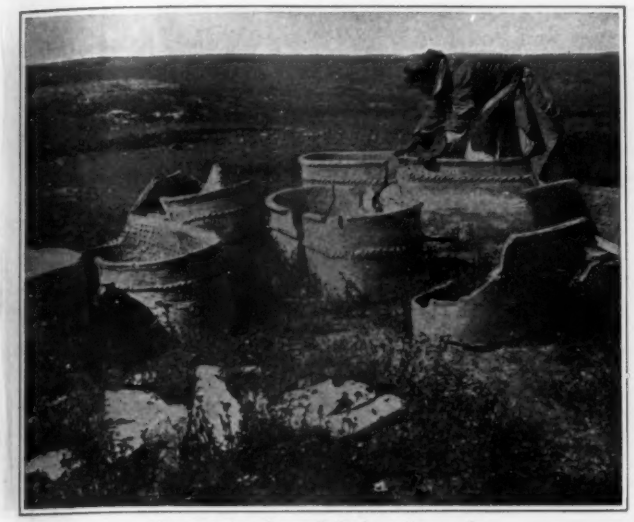
Granite lion crushing a man or standing over him.

General view showing Ishtar Gate and processional road.

The excavations on the mound of the royal capital of Babylon.

Round-roofed tombs of the Assyrians, built of sun-dried square thin bricks.

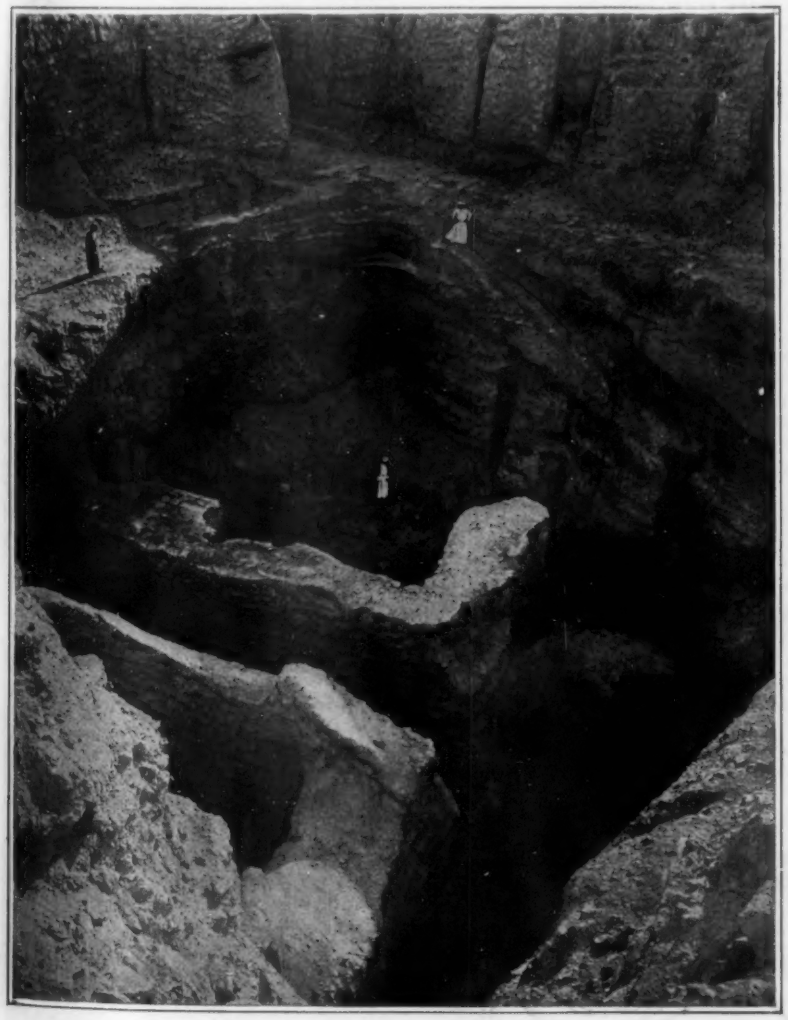
THE GERMAN EXCAVATIONS ON THE



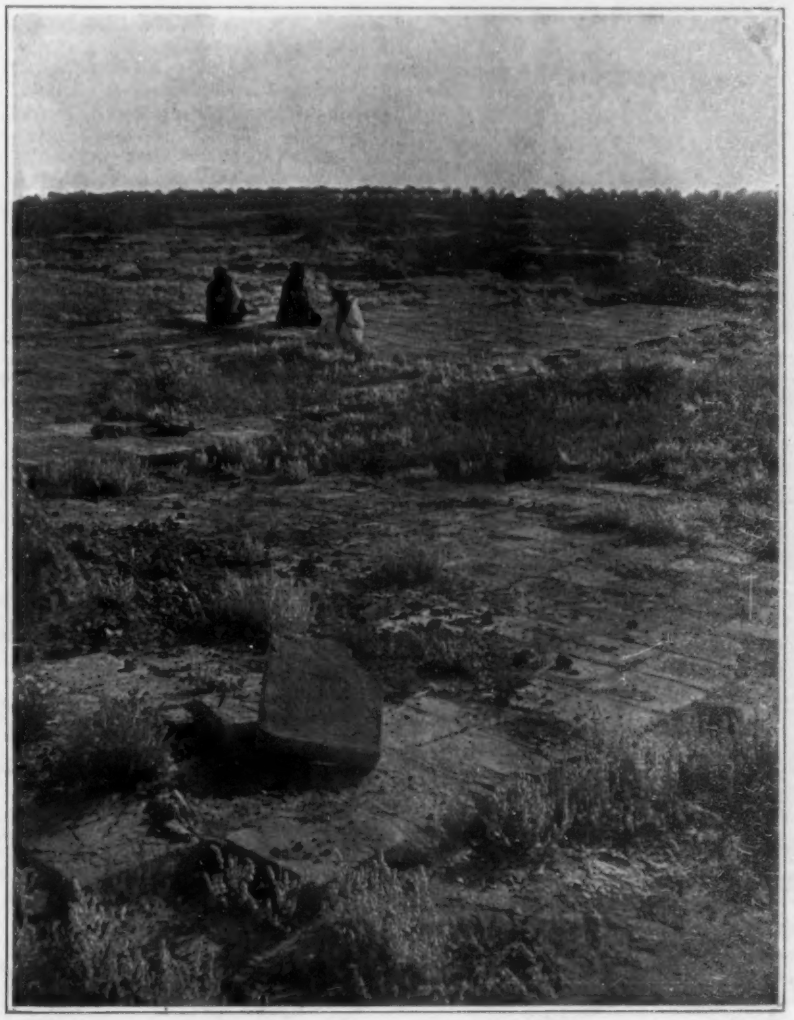
Fragments of sun-baked oval vessels.

Ruined edifices erected by Nabopolassar and Nebuchadnezzar II.

Trench leading to streets and foundations of Nebuchadnezzar's royal city.



Excavations on the site of the famous Esagil Temple.



Flooring of the supposed throne hall of Nebuchadnezzar

THE SITE OF ANCIENT BABYLON.

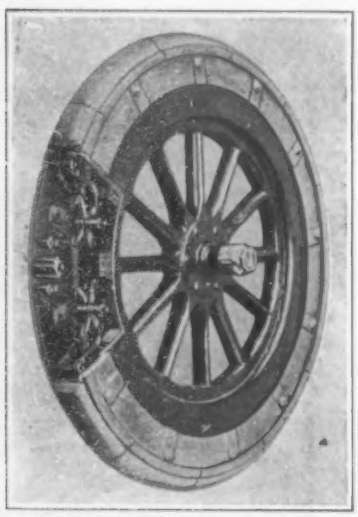
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Spring Substitute for a Pneumatic Tire

THE problem of supplying a substitute for the pneumatic tire for the wheels of automobiles is one that is interesting hundreds of inventors and designers of motor cars, and anyone who shall succeed in producing a tire which, while having the advantages of a pneumatic tire, shall be free of the disadvantages, should reap a reward which when measured in dollars and cents will more than justify the efforts in this direction. We show a wheel which is claimed by the inventor, Mr. Axel E. Ellis, to be a perfect substitute for a pneumatic tire, embodying what the inventor calls a "steel cushion," and which it is claimed duplicates in operation the resilient action of a pneumatic tire.

The wheel comprises a rim portion which supports a tire portion composed of segmental sections, these parts being made of steel. The segmental sections are pivotally connected to each other and are supported on what is termed a compression resistance mechanism, consisting of pivoted levers arranged in pairs, the levers at one end being connected by springs and at their other ends operating through thrust links to force the segmental sections radially outward. The wheel may have a steel tread, or the segmental sections may be provided with sectional treads of hard rubber or other material for the purpose of deadening the sound.



The "steel cushion" wheel.

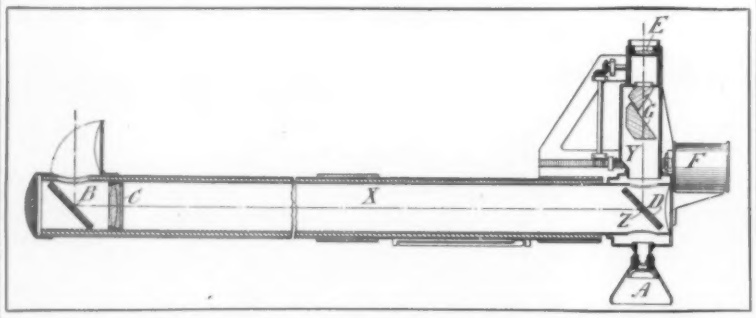
The operation is shown in the sectional views, wherein it is seen that the resistance to compression of any particular section which may be in contact with the ground is not wholly resisted by the parts of the compression resistance mechanism directly acting on that particular section, and this is accomplished as will be noted by the interconnecting springs which operate on the levers of adjacent sections, so that the compression of any one section is resisted by the springs, levers and thrust links of adjacent sections.

We are advised that these wheels have been tested on continuous runs over the roads of New York and the New England States, extending upward of three thousand miles, and that a Ford car, upon which they were placed, was in good shape after the test, and the wheels in perfect condition. For heavy truck wheels the treads may be of corrugated steel.

The effort of the inventor of the wheel was to secure a cushion tire as distinguished from a cushion wheel, the latter being objectionable because of the constant eccentricity of the continuous rim to the axle or hub. It is claimed for the Ellis wheel that the action is very similar to a pneumatic tire in that the effort to resist compression is exerted at points adjacent to the point of contact of the tire with the ground, as well as at that point.

A Single Instrument Range-finder

TWENTY-FIVE years ago, the British War Office advertised for a single instrument range finder, and this started inventors' activities along this particular line. The first instruments employed mechanical methods and depended on the angling of end reflectors with a micrometer to measure the angles to which these reflectors had to be turned in order to train them upon the object. The failure of these instruments was due to the difficulty of cutting the fine threads required. The stereoscopic principle was then employed and then the refracting prism, but the difficulty in the latter was that variations in the wave-lengths of the different colors of light produced errors in the reading. Yellow rays predominate if the air is saturated with moisture, red rays if the air be dry, and blue and blue-green rays on a dull cloudy day. The refraction varies of course with the predominating color, and as a result there are serious discrepancies between the readings on bright sunlight days and those on dull days.



Range finder comprising two telescopes with a single eye-piece.

The range finder we now have under consideration, like the original range finder, depends upon mechanical methods of measurement, but it does not contain the limitations of the original range finder, for the reason that machine tools of precision have been in the meantime perfected to such an extent as to permit of the desired accuracy of measurements. The improved range finder consists of two telescopes *X* and *Y*, one approximately at right angles to the other, but both having the same eyepiece *A*. The eyepiece is mounted in the side of the fixed telescope tube and the latter contains two reflectors mounted at an angle of forty-five degrees. Rays enter through the side of the fixed telescope and strike the reflector *B*. Thence they pass through the lens *C* to the other reflector *D*, which in turn directs them into the eyepiece. The reflector *D* has only the lower half of its surface silvered, so that the observer can look through the clear upper portion and see the image brought in through the lens *E* of the movable telescope. The movable telescope *Y* is turned on the axis *Z* by a fine vernier drum *F* until the object seen through the movable telescope coincides with the object seen through the fixed telescope. The object as seen through the fixed telescope is inverted. When this adjustment has been secured we have a right angle triangle with the axis of the fixed telescope at the base of the triangle and the axis of the movable telescope directed along the hypotenuse. As the base of this triangle is only three feet long, the angle between the axis of the fixed telescope and that of the movable telescope can vary but little from ninety degrees unless the object under observation is very close. If this angle is made 89 degrees 43 minutes the range figures out to 202.21 yards. By moving the telescope through the remaining 17 minutes or 1,020 seconds of arc, the range increases from 202.21 yards to infinity. The mechanism must therefore be constructed with such mechanical precision as to make it possible to detect an angle of one second of arc. In order to make the apparatus less bulky, prisms *F* are introduced into the movable telescope so that it can be materially reduced in length, while it has the same focal length as the fixed telescope. In order to permit of using the range finder at night, the vernier drum is provided with radium buttons at intervals representing fifty yards. The ordinary graduation on the drum can be made to read in 10, 15 or 20 yards.

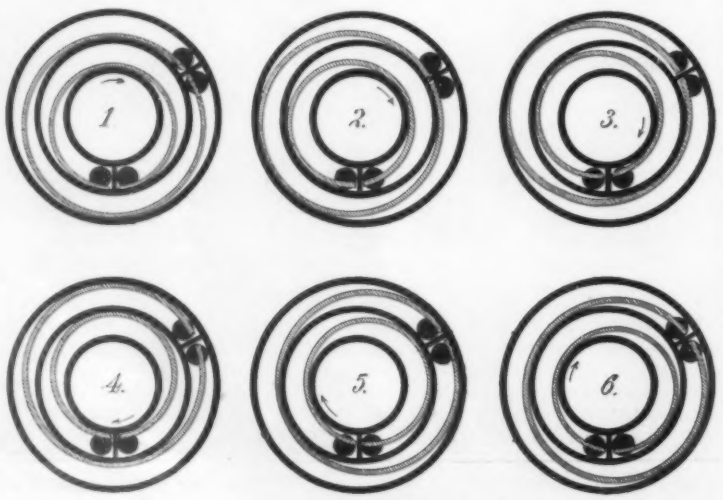


Diagram showing how the pumping is done by the eccentric movement of the annular flanges.

Improved Vacuum Pump

A VACUUM pump has recently been developed which is unique in that it contains no valves. Instead a novel mechanical movement is employed similar to that of the eccentric of a steam engine. In the body of the pump are formed two annular recesses into which project two annular flanges formed on an overlying plate. This plate, which is known as the "impeller," has an eccentric movement that causes the flanges to roll along the sidewalls of the annular recesses. Like the strap of an eccentric, the impeller has a circular movement without revolving about an axis. In other words, each point on the plate describes an orbit with a radius equal to the eccentricity of the plate with respect to the annular recesses. To produce this result, the driving shaft of the pump has an eccentric projection that enters an opening in the center of the impeller. The impeller is prevented from revolving on this center by a guide block, adapted to

The vacuum pump with superposed motor.

The impeller and the recessed body in which it operates.

slide in a slot in a fixed part of the motor frame. The eccentric projection may be turned to adjust the throw. The power shaft is driven by a motor mounted above the pump and connected thereto by means of a clutch. To prevent heating of the pump, the base is chambered to provide for water circulation.

The manner in which the pump operates is shown in the diagram. The walls of the annular recesses are shown by solid black lines, while the eccentrically moving flanges of the impeller are cross hatched. Each flange with its corresponding recess is a complete pump in itself, being provided with an inlet and an outlet port, as indicated by the black dots. The successive positions of the impeller are shown in the diagram. Fig. 2 shows an advance of sixty degrees over Fig. 1; Fig. 3 an advance of sixty degrees over Fig. 2, and so on, the advance being in the direction of the arrows.

Considering first the inner ring, it will be observed that as the points of contact progress in the direction of the arrow, the crescent shaped spaces on the left-hand side of the transverse partition are increasing, while that on the right-hand side are decreasing, so that air taken in through the left-hand port will be discharged through the right-hand port. The same is true of all the crescent shaped chambers produced on each side of the outer impeller flange. The parts are revolved in heavy oil, so that there is no danger of leakage. The pump may be used in the laboratory not only for the purpose of producing a high vacuum, but also, by leaving the suction side open, for producing a blast for a blowpipe. By reversing the operation of the pump, that is, introducing water under pressure into it, it may be converted into a motor. In fact, it is possible to use one of the impellers as a motor, and the other as a suction pump, for the inlet and exhaust ports may be entirely disconnected. Thus the city water supply may furnish the power to drive one part of the machine while the other is thereby caused to pump air.

Notes for Inventors

A Ball to Break up Deposits in Water Heaters.—In patent No. 1,046,591 George T. Hickmott of Pontiac, Mich., shows a water heating device comprising a shell externally heated and having inlet and outlet openings and an inclined partition extending partially across it between the openings. A ball is free within the shell and rolls upon its bottom and also on the partition off which it rolls should it be thrown up on the partition by the agitation of the boiling water. The purpose of the ball is to break up deposits of lime on the bottom wall and keep the wall clean and free of coating when hard water is being used.

A Novel Cheese-server.—In patent No. 1,046,920, to Elie P. Dautlon of New York, is provided a cheese cutting device having a rod to penetrate the cheese at its middle and a number of independently movable blades which swing upon and are movable longitudinally along the central rod, so that they can be utilized as cutters to cut slices from the cheese and also as a cover for the cut edge of the cheese.

Substitute for the "Kiss of Death" Shuttle.—News comes from Massachusetts that its mill workers are demanding enforcement by the attorney general of that State of the anti-"kiss of death shuttle" law. Along this line it is interesting to note the issue of a patent, No. 1,047,957, to Herbert L. Litchfield of Southbridge, Mass., for a shuttle threader which has a stiff, unyielding shank and an extremely flexible, resilient hoop portion at the end of the shank and adapted to enter the eye of the shuttle, the hook portion having at its extremity an open eye and being of such length that when the threader is inserted into the shuttle eye as far as the shank will permit, the open eye of the threader is situated above the shuttle in proper position to receive the thread on the bobbin.

Base Ball Making.—As is well known, base balls are covered by two dumbbell-shaped cover pieces. Frederick H. Perry of Beverly, Mass., has secured a patent, No. 1,048,092, for a method of making base balls in which the two dumbbell-shaped cover pieces are applied to a ball center with a layer of cement between the center and covers and a series of wiping blows are delivered against the cover pieces to shape them and cause them to adhere to the ball center, after which the edges of the cover pieces are trimmed and sewed together.

A Machine that Folds and Inserts Sheets in Envelope.—An Atlanta, Georgia, man, William Henry Young, has secured a patent, No. 1,046,707, for an apparatus in which a pack of envelopes are held with their flaps opened and a folding machine has a blade which folds a sheet into two parts and then again folds the folded parts and the blade is then engaged with the sheet to insert the folded sheet into the envelope.

A Sanitary Drinking Fountain.—The purpose of patent, No. 1,047,762, is evidently to prevent any one from using a sanitary drinking fountain in an unsanitary manner. The patent which issues to H. Mueller Manufacturing Company, of Decatur, Ill., as assignor of John C. Davis of Dighton, Mass., shows a nozzle which furnishes a drinking jet or bubble and also furnishes means to supply a secondary discharge of liquid so positioned as to wet a person before his face can come in contact with the nozzle, the nozzle being so discharged as to permit the person to drink without receiving a bath.

An Electric Signaling Glove.—In patent No. 1,046,225 Charles A. Schindler of West Hoboken, N. J., combines with a glove, a source of electricity such as a battery carried by the glove and has an electric audible alarm mounted on the glove and an electric lamp also mounted on the glove. Circuit wires connect the source of electricity with the lamp and with the alarm, and spaced contacts for the circuit wires are arranged on certain fingers of the glove and a circuit closing contact on another finger and adapted to engage either of the spaced contacts to close the corresponding circuit so the signals and alarm can be operated at will.

A Car-brake Shoe.—In patent No. 1,046,423 to Pittsburgh Brake Shoe Company as assignee of John Jacob Kinzer of Wildwood, Pa., is shown a brake shoe which has an inclosing casing formed of wire fabric and in this fabric is a filling of frictional material with the sides of the casing corrugated.

Some Charles Francis Jenkins Patents.—The well-known Washington inventor, Charles Francis Jenkins, has recently issued five patents, one, No. 1,047,527, being for a gas engine starter in which there is a pump casing, plunger and operating crank shaft with a projecting end and a rotary distributor supported upon such end and telescoping the shaft and revoluble thereon with power devices acting between the pump casing and the projecting end of the shaft to rotate the distributor shaft and means for causing the distributor shaft to rotate the crank shaft at will. A second patent, No. 1,047,528, is for a motion picture apparatus involving improvements in connection with the projecting machine film box and film drum with a friction disk on the drum shaft and drum-driving devices as specified. A third patent, No. 1,047,529, is for a valve for use in connection with an engine cylinder, while a fourth patent, No. 1,047,530, is for an apparatus for providing boxes with closures and including a vertical wheel having a series of peripheral radially opened pockets in which receptacles are placed and to which they are delivered laterally, the wheel being rotated step by step and the die and plunger being provided for forming and inserting the closures. The fifth Jenkins patent, No. 1,047,531, is for a valve which is adapted to be opened by fluid pressure from one side and is combined with devices arranged to lock the valve positively in closed position when the pressure is lacking.

Legal Notes

Failure to Testify and the Presumption it Raises.—The case of Steinberger v. Hewlett decided by First Assistant Commissioner Billings, presents some peculiar questions. It was an interference between two sole applicants and the Commissioner said that viewing the cases merely as those of two independent inventors "it is very clear that Steinberger would fail." But it appeared from the record that a joint application was filed by one Buck and the party Hewlett for the invention of the issue prior to the sole application of Hewlett, which joint application became abandoned. It was contended by Steinberger in his testimony that he disclosed the invention to the party Buck, and that the records of the Patent Office placed in evidence raised the presumption that Buck disclosed the invention to Hewlett. Hewlett elected to present no testimony so that no testimony is presented in his behalf to rebut the presumption claimed in behalf of Steinberger.

The Commissioner said that "where in a case involving the question of originality, an inventor fails to take the stand who is available as a witness when the facts in his favor, if any there be, are peculiarly within his knowledge, the legal presumption follows that his testimony would be unfavorable to his case" and reversed the decision of the Examiners in Chief and held Steinberger to be the original inventor of the issue.

Recently Adjudicated Patents.—Of nine adjudicated cases in a recent list, the DeMoulin patent, No. 555,499, for initiation apparatus for secret societies was held void for lack of patentable novelty in Alexander v. DeMoulin Brothers & Co., 199 Fed. Rep., 145: Claim 2 of the Steinmetz patent, No. 559,913, for an alternating current system of distribution, was held not infringed in General Electric Company v. Allis-Chalmers Company, 199 Fed. Rep., 169; the Baldwin patent, No. 656,874, for an acetylene gas-generator lamp was held valid and infringed as to claim 1 but not infringed as to claims 2, 3, 4, 5, 6 and 10 in Bleser v. Baldwin, 199 Fed. Rep., 133: the Van Auken patent, No. 828,153, for discharge valve for steam-radiator was held not anticipated and valid, but not infringed in Monash-Younker Company v. Van Auken, 199 Fed. Rep., 123: the Eggleston patent, No. 838,394, for a relief device for water systems was held valid and infringed in Eggleston v. Milwaukee Heater Manufacturing Company, 199 Fed. Rep., 147: the Boldt design patent, No. 39,921, for a design for a bottle was held void on its face for lack of patentable invention in Charles Boldt Company v. Turner Brothers Company, 199 Fed. Rep., 139, and The Evans design patent, No. 41,785, for a design for a lampshade was held valid and infringed in Macbeth-Evans Glass Company v. Rosenbaum Company, 199 Fed. Rep., 154. The Webster design patent, No. 40,789, for a design for a clothes brush, has been held valid and infringed in Foster & Brother Company v. Tilden-Thurber Company, 200 Fed. Rep., 54; the Redington patent, No. 625,517, for a mucilage holder, has been held not infringed in Redington v. Office Equipment Company, 200 Fed. Rep., 57; the Wurt's patent, No. 570,416, for a circuit interrupting device, has been held, as to claims 3 and 4, void for lack of patentable invention in Condit Electric Manufacturing Company v. Westinghouse Electric and Manufacturing Company, 200 Fed. Rep., 144; the Carleton patent, No. 481,254, for a hair clipper, has been construed and held not infringed in Brown & Sharpe Manufacturing Company v. Coates Clipper Manufacturing Company, 200 Fed. Rep., 149; the Joy patent, No. 780,664, for a printing telegraph receiver, as to claim 12 as modified and limited by the disclaimer filed, has been held valid and infringed in Page Machine Company v. Dow, Jones & Co., 200 Fed. Rep., 72, and Gale patent, No. 685,328, for rubbing and polishing machine, has been held valid and infringed in Moore Carving Machine Company v. Lucas Machine Company, 200 Fed. Rep., 77.

Trade-mark Notes

"Bona Fide" Refused Registration.—First Assistant Commissioner Billings in *ex parte* Eisenstadt Manufacturing Company has refused registration of the words "Bona Fide" as a trade-mark for music boxes, watches, etc., since these words would indicate to the average purchaser that the goods upon which they are placed are genuine and that the mark is therefore descriptive.

Tire and Automobiles Not the Same Goods.—In the case of G. and J. Tire v. G. J. G. Motor Car Company, First Assistant Commissioner Billings has held that rubber tires and automobiles are not goods of the same descriptive properties and that the use of a mark upon tires was no bar to the use of the same mark upon automobiles by another.

No Appeal to Court of Appeals in Trade-mark Renewals.—The Court of Appeals of the District of Columbia by Mr. Justice Van Orsdel, in the case of the Standard Oil Company of New York, has held that under the provisions of the Trade-mark Act of 1905 no appeal lies to the Court of Appeals of the District of Columbia from the decision of the Commissioner of Patents refusing to renew the registration of a trade-mark.

Recording Trade-mark Assignments.—First Assistant Commissioner of Patents Billings in disposing of the petition of the Alart & McGuire Company has held that an assignment of a trade-mark is not recordable, which, while purporting to convey the good will of the business, obviously retains in the assignor title to a business which is not segregable from that attempted to be transferred. At the same time, he holds that an assignment of a registered trade-mark must be recorded merely because it does not transfer the good will of the business as to all the goods set up in the registration, where the goods mentioned in the assignment are so different from the other goods named in the registration certificate, that the business in the one is segregable from that in the other. He also holds that in considering this question all reasonable doubts should be resolved in favor of recording the assignment.

World-wide Trade Marks.—There is a movement on foot seeking to secure the world-wide recognition of trade-marks. How far this will meet with favor among the commercial nations of the world remains to be seen. By a resolution passed at the Newcastle meeting of the Association of British Chambers of Commerce, the British Government has been urged, in a letter addressed to the Secretary of State for Foreign Affairs by the Association's secretary, to press upon foreign governments the necessity of establishing as an international law that "first public use" shall be the fundamental condition of ownership of a trade-mark. In ome countries priority of registration excludes use by owners, and user antedates the registration. It is promised that the subject shall be brought up for decision at the next International Conference for the Protection of Industrial Property.

The Amended Trade-mark Act.—In the amendment enacted and approved in the early part of this year to the trade-mark statute, it is provided that no mark shall be registered which consists of or comprises any name, distinguishing mark, character, emblem, colors, flag, or banner adopted by any institution, organization, club, or society which was incorporated in any State in the United States prior to the date of adoption and use by the applicant: provided that said name, distinguishing mark, character, emblem, colors, flag or banner was adopted and publicly used by said institution, organization, club, or society prior to the date of adoption and use by the applicant. The effect of this will doubtless be to enable any institution, etc., incorporated as specified and having used the mark as set forth in the statute to oppose and prevent the registration by a subsequent adopter of the mark.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

ATTACHMENT FOR GATES.—J. GERST, care of W. P. Gerst, Alton, Iowa. The intention in this case is to provide means by which a swinging gate may be raised or lowered at will. A further object is the provision of means for raising and lowering a gate and for maintaining the same at any desired height.

CORN PLANTER.—A. F. STARR, 177 W. 37th St., Los Angeles, Cal. This invention provides a planter arranged to plant or drill a plurality of rows at one time, to properly prepare the ground for the reception of the seeds and to subsequently cover the seed to insure a ready germination thereof.

Of General Interest.

METER BOX AND METER CONNECTION.—W. SIEBER, care of C. A. Hart, Water Works Dept., Henderson, Ky. This inventor provides connecting means for use in a meter box adapted to contain any of the standard meters for water or gas, the construction being such that it is only necessary to have the box large enough to admit the meter, since the connection set forth which engages the meter requires no extended labor or time in placing the meter in service or in removing it therefrom.

DEVICE FOR MOUNTING ARTIFICIAL PEARLS.—G. BRUNET, Herblay, Dept. of Seine-et-Oise, and L. AUBA, No. 11 Rue Pastourelle, Paris, France. In the present patent the invention has reference to a novel means for securing an artificial pearl to the stem or shank of a stick-pin or like device, in order that the pearl may be securely fastened, while at the same time the fastener elements will be effectually concealed.

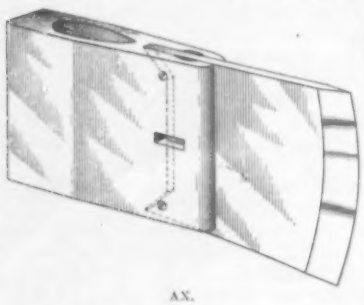
PLASTIC MATERIAL.—H. BIZZARRI, 58 Spring St., New York, N. Y. This inventor provides a material for the formation of the heads, bodies and limbs of dolls, ornaments, statues or other articles for decorative and other purposes, which is homogeneous throughout, practically indestructible, exceedingly

A FIGURE OF PLASTIC MATERIAL.

light, not unduly influenced by moisture, heat or cold, and capable of being readily molded into any desired shape and sufficiently soft to permit cutting or chiseling the same or driving nails through it for fastening the article to a wall or other support without danger of splitting or cracking the material.

Hardware and Tools.

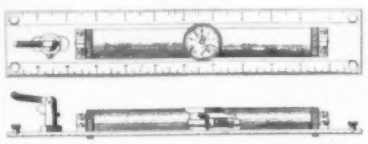
AX.—A. F. KOURIVA, Stony Brook, L. I., N. Y. This implement has an ax head and a removable bit to permit of replacing a worn out or broken bit with a new one, and securely to hold the removable bit in position in the ax head. The ax head is provided with a socket for the handle and with a groove



AX.

for the reception of the back of the bit, the groove being provided with a socket for the handle and with a groove for the reception of the back of the bit, the groove being provided with beveled seats and the back of the bit with beveled lugs adapted to engage the seat to center the bit on the ax head and to hold the bit against accidental movement in an up and down direction.

PARALLEL PROTRACTOR.—C. P. EAGER, care of U. S. Surveyor General's Office, Reno, Nevada. The protractor consists of a body mounted on a pair of milled rollers rigidly attached to a connecting shaft. In the middle of the instrument an indicator is mounted whose pointer is turned by a gear attached to the shaft connecting the two rollers. At one end is a lever attached to a cam which works on a pin, and when the lever is lowered, the pin coming in contact with the drawing board raises that end of the instrument which now revolves in a circle, the pin as a center. The

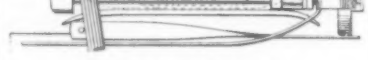


PARALLEL PROTRACTOR.

indicator announces the number of degrees being turned off, and when the desired angle is reached the lever is raised. The instrument now rolls to the point from which the line is to be drawn. Means permit lines several times the protractor's length to be drawn. They slide either way and are graduated on both upper and lower faces to different scales. They are interchangeable and give four different scales. It is especially for field work, and will plat without a vernier, to one minute of arc.

Machines and Mechanical Devices.

PICKER HEAD CHECK.—A. A. PERKINS, care of Liverpool, London and Globe Ins. Co., Sanford, Maine. This invention relates to looms, and its object is to provide a head check arranged to stop the picker head and hold it in proper place for receiving the im-

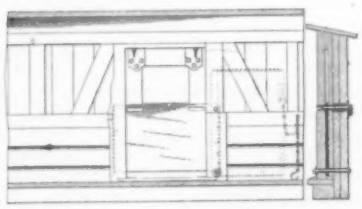


PICKER HEAD CHECK.

pact of the returning shuttle. For this purpose use is made of a spring-pressed cam mounted on the shuttle box and adapted to be engaged by the picker head to hold the latter in an outermost or receiving position for the shuttle.

Railways and Their Accessories.

ADJUSTABLE GRAIN DOOR.—H. W. F. JAEGER, 1127 E. 71st St., Cleveland, Ohio. This invention has reference to improvements in doors for cars designed to carry grain, and has for an object an improved structure which

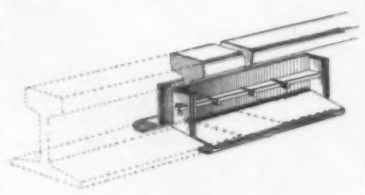


ADJUSTABLE GRAIN DOOR.

may be adjusted or expanded so as to permit grain of different weights to be shipped in the same car without changing the door and without reducing the amount of grain which may be safely shipped in any particular car.

TEMPORARY TIE HOLDING DEVICE.—H. A. WITZIG and J. A. FREMON, Leeper, Mo. This invention provides a device possessing sufficient resiliency to withstand the shocks while the spikes are being driven into the tie. It provides a device with which the tie may be brought against the base plate of the rail in a perfectly vertical direction, and held there automatically until attached to the rail.

RAIL JOINT.—A. W. STEBBINS, Abbeville, La. In the present patent the invention has for its object the provision of a new and improved rail joint of simple construction and involving few parts, by means of which the rails are firmly held in place while readily re-

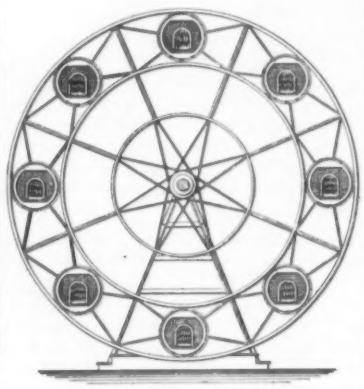


RAIL JOINT.

sponsive to any expansion and contraction. In the accompanying illustration is clearly shown a perspective view of a rail joint embodying the invention.

Pertaining to Recreation.

OBSERVATION CAR.—A. F. BIAVATI, 1482 Third Ave., Manhattan, N. Y., N. Y. An object of the invention is to provide an observation wheel with a plurality of independently rotating cars arranged to remain in a vertical position by gravity and by such action trans-



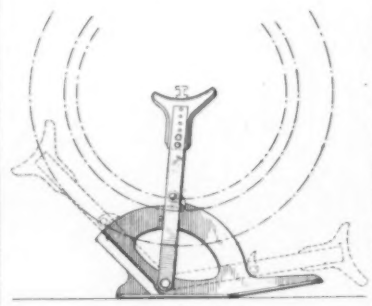
OBSERVATION CAR.

mit power to propelling mechanism for propelling the car a certain number of turns in one direction in a horizontal plane, and then a certain number of turns in an opposite direction.

Pertaining to Vehicles.

SHOCK ABSORBER.—C. W. SNOWDEN, Isabel, Guantanamo, Cuba. This invention relates to attachments for vehicles, particularly motor-driven vehicles, to absorb the severe shocks to which the vehicle is subjected, the absorber acting to take up the vibrations due to the yielding and recoil of the springs supporting the vehicle body.

VEHICLE JACK.—W. T. ADAMS, care of W. T. Adams Machine Co., Corinth, Miss. This improved jack is adapted for lifting wheels of vehicles, especially automobiles, when the vehicles are run over a jack, so that the latter engages the axles. The block may be



VEHICLE JACK.

adjusted higher or lower as may be required to accommodate the jack to different vehicles; and when the jack is not in use, the axle support may be turned down to the right, as indicated by dotted lines in the engraving, and thus the jack as a whole will occupy comparatively small space and may be conveniently carried in the auto or other vehicle when required.

Designs.

DESIGN FOR A SERVING TABLE.—C. A. FAISSOLE, 411 W. 44th St., Manhattan, N. Y., N. Y. In this ornamental design for a serving table the form of the article is made on simple yet very graceful lines. Two drawers are in front; a shelf for use in resting ware projects from either end and a shelf for use in holding empty dishes is under the top of the table and supported by the four legs.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

INQUIRY COLUMN

Inquiry No. 9298. Wanted the name and address of a manufacturer of spun glass.

Inquiry No. 9298. Wanted the names and addresses of concerns who can turn irregular shaped handles in wood, similar to gun-stock work.

Inquiry No. 9299. Wanted name and address of the maker of a machine for driving fence posts into the ground.

Inquiry No. 9300. Wanted the name and address of a maker of a patented keyless door lock.

Inquiry No. 9301. Wanted the names and addresses of a few concerns who can do machine embroidery according to the design furnished, at reasonable rates.

Inquiry No. 9302. Wanted the address of the manufacturer of the Greenfield flexible armored conductors or cables. This is a double galvanized, spiral conductor or cable.

Inquiry No. 9303. Wanted the name of manufacturer who could make newly patented articles made from 13 to 22 gage sheet aluminum.

Inquiry No. 9304. Wanted the names and addresses of manufacturers of a second hand bag cleaning machine on the order of a carpet cleaning machine.

Inquiry No. 9305. Wanted the name and address of concerns making paper letters and figures.

Inquiry No. 9306. Wanted small hardware and other specialties to be sold in notion and grocery stores. Wanted to buy wholesale.

Inquiry No. 9307. Wanted to buy a machine for honing and stropping safety razor blades on a commercial scale.

Inquiry No. 9309. Wanted to buy small woven tubing of small diameter for use over the temples of spectacles where they go around the ears.

The Decline of Native Forest Trees in Cities

Some Means of Prevention

By Myron H. West

AVERY obvious and deplorable fact concerning our native forest trees, which have been forced to undergo artificial environment and exist amid unnatural conditions, is found in their tendency to degenerate and in many cases to die out altogether. Where once bordering our streets, in the public parks and on private estates, fine old native trees flourished, now are to be seen in many cases only small nursery grown specimens which fail utterly to give that effect of grandeur and that enchanting historic suggestiveness which was so true while their places were filled with the picturesque conifers, the gnarled oaks and the grand old specimens of ash, cherry and elm.

It is oftentimes difficult to determine the exact cause responsible for such tree decline, especially in view of the fact that younger trees transplanted from a nursery often thrive in the same conditions. In many cases, however, it may be attributed to soil and drainage conditions which have undergone a marked change with the building of lawns, streets and other improvements. Root systems are oftentimes mutilated to an irreparable extent by the building of foundations to houses, the installing of curbs and by laying of water, gas and drainage pipes. In such cases care could be taken to make smooth cuts and paint or tar the surfaces, so that much loss of sap would be prevented and the tree saved a material loss. It is also a wise procedure to prune back a tree thus mutilated so that the amount of evaporating surface of the leaves would tend to balance the decreased root system.

In the changes of soil condition from those existing in the original forest lies perhaps as potent a danger as any to tree life. In its natural state, the forest floor was covered with a thick mat of decayed leaves and twigs forming a sponge-like material which retained the moisture, and in its lower stratum furnished an abundance of well prepared, easily assimilated food material. It was also a non-conductor and extremes of heat and cold were not easily transmitted to the tender feeding rootlets attracted to it from the lower depths. In the grading and seeding of lawns, this ideal condition for tree growth is done away with and a hard tramped surface, covered only with short cropped grass, takes the place of the loose, nutritious and moisture retaining mulching. Whereas lawns may be kept green by repeated sprinkling, rarely do the tree roots get enough moisture under such conditions.

In watering trees, the hose should be allowed to run until the lawn is flooded, and the water has permeated to a depth of two feet. But wherever possible the natural conditions once prevailing should be replaced. Spade the ground around the old tree out to a distance of fifteen feet or so, as far as the branches extend, and spread on this area a layer of well rotted leaves or compost six inches thick. Herein plant periwinkle, ferns or ivy, something to form a thick ground cover. This will restore a semblance of natural woodland attractiveness and prove a boon to the suffering tree.

Oftentimes the lowering of the natural water table, the level at which free water stands, interferes with the vitality of the trees. This often occurs by reason of installing sewer or drainage systems. Proper precautions taken relative to conserving the surface moisture will, however, obviate this difficulty to a great extent. Where street pavements and sidewalks have resulted in covering a large proportion of the root system, unusual precautions are necessary to maintain tree health. Air and water may be supplied to the roots in such cases by installing a radiating system of land tile leading from a common center to all parts of the root area.

Next to the changing of soil conditions perhaps the greatest agencies for tree destruction are smoke and gas. Trees grow-

ing in cities soon become covered with soot, the oily, adhesive substance filling the stomata of the leaves and rendering them unable to properly fulfill their function of interchanging oxygen and carbonic acid gas. The leaf structure of certain species of trees enables them to cope more successfully with this danger than is true of others, and this fact should be considered in planting trees in smoky districts. To safeguard existing trees, washing should be resorted to; a thorough spraying with soap and soft water, followed with a more forceful rinsing of clear water, will free the leaves of most of the accumulative soot.

Gas from leaky pipes is a danger for which one should be ever on the alert. A tiny leak for a long time is perhaps the most dangerous on account of the difficulty of detection and the sureness of destructive results. A tree affected by gas poisoning usually first shows signs of sickness in the top branches, the leaves early turning yellow and falling, the bark begins to loosen and to become infested with fungi. Borers begin their operations and a sour repugnant odor is discernible. Although rarely possible to save the life of a tree in an advanced stage of poisoning, heroic efforts taken during the early symptoms may succeed. First remove the cause by installing new gas pipes, if possible at a more remote distance from the tree. Replace the soil from over and around the roots. This should be carried out with extreme care, uncovering a part of the root system at a time, soaking the under layer of the earth generously with water and replacing the soil removed with a fresh fertile mixture of well rotted compost and top soil with an admixture of sand where necessary to produce the proper mechanical conditions. The tree should then be sprayed for insects and fungi and carefully pruned. A thorough watering should be given twice a week throughout the summer. Oftentimes borers attack gas affected trees with unusual frequency. Spraying with a solution of whale oil soap during the summer will prevent the female beetles from laying their eggs and later, in September or October, while the young grubs are operating just under the bark, they may be detected by the fresh wood dust and killed by following their burrows with a soft wire or by injecting a little carbon bisulphide with a medicine dropper and stopping the orifice with putty and clay. The attacks from insects and fungi are usually secondary to more important reasons for the tree decline, and should receive careful attention in the work of rejuvenation as they are loath to leave the host after its health has been otherwise restored.

The two great groups of parasitic insects, the leaf eaters and the sucking or scale insects, may be brought into subjection usually by careful applications of stomach and contact poisons, respectively, but a knowledge of insect life and habits is necessary to successfully undertake such work.

Electric currents from wires coming in contact with wet branches often kill or mutilate trees and mechanical abrasions such as caused by horses, lawn-mowers and the like are productive of great harm.

It is reasonable to assume that unusual ailments brought about through the advent of artificial conditions and environs should be met with artificial methods of treatment, a fact which has led to the development in recent years of a specialized line of work commonly known for want of a better term as "tree doctoring" or "tree surgery." Like all other avenues of endeavor it is likely to be productive of quacks as well as of skilled and efficient practitioners. There is no doubt that through the efforts of this new department of agriculture, many valuable old trees have been saved to future generations. In tree surgery as in human surgery, there is often, however, a tendency to over-operate.

Pruning of ornamental trees should be limited in most cases to the taking off of dead branches. Seldom is there any need of doing more save in cases where branches cross or interfere or where they interfere with desired vistas. To remove

dead or dying limbs is, of course, but a matter of good housekeeping, but should be carried out intelligently, for a tree once mutilated must stand on for years in mute reproach to the perpetrator of the act. Limbs should be cut off in a line with the trunk in such a way as to present the side of the cut in direct contact with the downward flow of elaborated sap. Start the cut from the underside to prevent stripping the bark and paint the wounds with a mixture of white lead and boiled linseed oil, but not with the cheaper brands of prepared paint. Where decay has pentrated the tree, clean out all rotted matter following into the hardwood until all fungus mycelia have been removed. Form the cavity in such a way that it will enlarge as it recedes from the opening at all points except at the bottom, where it should slope downward and outward to allow the draining of any sap or moisture which may collect behind the filling. Treat the interior of the cavity with the exception of the area near the opening with creosote and fill with concrete colored a dark gray with lamp-black, carrying the surface well back and even with the cambium layer and leaving it slightly convex in shape. In large cavities, steel reinforcement should be used and the cement inserted in sections separated with tar, so that the swaying of the tree will result in a slight opening of the joints rather than in cracking of the concrete. Although filling cavities in trees only results in forming a mechanical support, the process of filling should be carried out along strictly scientific lines, following engineering rules and at the same time doing the work with the care and precaution that a dentist would use in filling a tooth. A filling with cement when not properly made is probably of more danger to the tree than good unless the cavity is thoroughly cleaned and disinfected. The space behind the filling becomes a veritable breeding ground for parasitic fungi and insects, resulting in the ultimate destruction of the tree. This is especially true in the case where the cavities are thoroughly covered over with sheets of metal.

The process of bolting and supporting trees by mechanical means is one which may be carried to extremes, the danger being that by the insertion of too many bolts of too large a diameter the branches are weakened instead of strengthened. Bolts should always be placed through the limbs instead of around as bands, and should only be of sufficient size to furnish necessary support. They should be formed with a link midway between the ends to take up the motion caused by the swaying of the trees. The heads should be counter-sunk and set in tar or asphalt to prevent fungus spores from entering alongside the bolt. It is usually only necessary to bolt together limbs which spring from crotches which have become split or weakened. The tying together of tree limbs with a maze of iron rods is always unsightly and usually it is not necessary.

Oftentimes trees or groups of trees become of great value by reason of their size, beauty, location or historic connections, but they are usually worth far more to their owner and to the public at large than merely what corresponds with these virtues and the matter of prolonging the life and beauty of fine old trees becomes well nigh a matter of civic duty in various cities, and cannot be too strongly commended.

How the Indians Harvest Wild Rice

A REPORT from the American consul at Kingston, Ontario, gives a graphic account of the wild rice harvest, which was in progress at the time of writing along the shores of Rice Lake, lying a few miles north of Cobourg. Here, as in other parts of southern Canada, and in Minnesota and Wisconsin, the gathering of wild rice is the peculiar prerogative of the Indians, who from time immemorial have used this grain as one of their principal foods, besides selling it to the whites. In pioneer days, it was a common food of the European settlers, especially those engaged in the fur trade. In more recent times it has come to be regarded as a luxury by white people, as it sells for two or three times as much as ordinary white rice. In this country Chicago is still an important market for wild rice.

This plant (*Zizania aquatica*) is, of course, quite different botanically from true rice; it has a long black grain, and hence is sometimes called black rice, but it has scores of other names in English, French, and the Indian tongues. According to Dr. Jenks, the principal authority on this plant, "more geographic names have been derived from wild rice than from any other natural vegetal product throughout the whole continent." The Menominee Indians derive their name from it. It is the most nutritious cereal in America, and many attempts have been made to extend its cultivation, but without much success. To the average American it is probably best known as a favorite food of wild ducks and other waterfowl.

In harvesting this grain the Indians use the same simple methods that were followed by their remote ancestors. We quote from the consul's description as follows:

"In gathering, sheets are laid in the bottom of the canoe and a start is made for the rice beds. A man sits in the bow of the boat and paddles, while his helpmate takes up a position in the stern and with the aid of two stout sticks bends the stalks over the canoe and thrashes the rice into the bottom of the boat. This continues until the boat is nearly full, when the rice is taken to shore and spread out to dry. After a few hours in the hot sun the grain is ready for parching. This is usually done by the women, who place it in a large iron pot and heat it over a slow fire, stirring it continually until it is "parched." It is then ready for thrashing. This is done by one of the men putting it in an iron pot or large wooden bowl hollowed out of a log, and with moccasins on his feet and trousers tied tightly around his ankles, he jumps on it until the grain is separated from the chaff. The last operation is that of sifting. The rice is poured into birch-bark baskets, in small quantities, and squatting down in front of the tents on the shore, under the trees, or any place where there is a good breeze, the women gently shake until the chaff is separated from the grain, and is blown away by the wind. Crude as it may seem, it is exceedingly effective, and the workers are scrupulously clean throughout the whole process."

Protection of Ocean Liners by Subdivision

(*Concluded from page 356.*)

security throughout the central portions of the length of the ship against flooding of the boiler and engine room spaces.

The new construction that has been put into the "Imperator" consists in the construction of an inner skin, from 3 to 4½ feet from the outer skin, which extends from the bulkhead at the forward end of the boiler room spaces, clear to the bow, and reaches from the floor of the ship to several feet above the load water line. We present a photographic view of this work, which shows at the left the sloping outer skin at the bow of the ship, and at the right the new interior skin. It will be noted that the heavy framing of this inner skin is well calculated to stand heavy water pressure, in the event of flooding through injury. An additional precaution has been the construction of two large trimming tanks aft of the peak tank, which extend the full width of the ship and are closed in by watertight steel floats, approximately at the load water line of the ship.

Both of these companies are to be congratulated upon the promptitude with which they have applied the lesson of last year's disaster, and the very thorough manner in which the two great ships have been rendered secure against sinking through under-water damage of any description.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12777) M. R. writes: First, given two surfaces, one plain, the other corrugated, but the same dimensions. The area or square surface exposed of the first surface is greater than that of the second. Each is in contact with the air on one side only; then, will the atmospheric pressure be greater on the first than on the second, or will it be the same on both? A. The atmospheric pressure is the same on both the level and the corrugated surface. The reason is that only that component of the pressure acts directly upon the surface which is at right angles to the surface. It is the same idea as this that no more houses can be built or trees set out on a side hill than could be on the level plain which would be made by removing the hill. 2. Is the same amount of energy expended in the complete operation of raising a hundred-pound weight a height of ten feet when pulleys or tackles are used as is expended when the weight is lifted without them, as by direct application of the hands to the weight? Also, give the answer in regard to the same operation when performed with the aid of levers. A. If you can lift a weight up to the place where you want it, there is no advantage in employing a machine to raise it. It matters not whether a lever or pulley or any other machine be used. A machine enables a man to raise a weight heavier than he can lift by his own power, but he must move it more slowly, in exactly the same ratio as it is greater than he can raise by his own effort alone. No machine creates power. It wastes power by its friction and the power used in running it.

(12778) J. S. N. asks: Will you please advise me in your Answers to Queries if the North Magnetic Pole is situated in latitude 70 degrees north and longitude 97 degrees west? Is the South Magnetic Pole situated exactly opposite, which would make it 70 degrees south latitude and 83 degrees east longitude? When the North Magnetic Pole varies its position, does the South Magnetic Pole shift with it, so that they always maintain positions exactly opposite on the earth's surface? A. The earth's North Magnetic Pole was visited in 1831 by Sir J. C. Ross, and located in latitude 70 degrees 5 minutes north, and longitude 96 degrees 46 minutes west. It was next visited by Amundsen in 1907, and was found to be in latitude 75 degrees 5 minutes north, and longitude 96 degrees 47 minutes west. The South Magnetic Pole was located by Lieut. Shackleton's party in 1909 in latitude 72 degrees 25 minutes south, and longitude 155 degrees 4 minutes east. No further data are accessible. We shall have to wait for a visit by other explorers before we can know about changes. Our figures for the location of the South Magnetic Pole are taken from the *National Geographic Magazine*, April, 1909, page 401, where there is a misprint in the longitude. You will see that the South Magnetic Pole is not diametrically opposite the North Magnetic Pole.

(12779) J. B. W. writes: In your Notes and Queries of February 1st, 1913 (12741), R. E. P. asks: "Where did these worms come from?" Your answer was, you could not account for the fall of worms as described; also that it was not probable that a scientist could give a better explanation than a common-sense man. In your issue of March 1st, 1913 (12753) C. W. B. says there are no hatcheries in the clouds for breeding angleworms, toads or frogs, and their sudden appearance has developed the popular fallacy that they have rained down. Will C. W. B. explain then how angleworms, toads and little red lizards got up on a trestle eighty feet from the ground, where I found them? Had the angleworms been in the hot planks before the shower of rain that brought them, they would have been fried to a crisp. Again, I would ask, How did those angleworms get into our rain barrels? Did they not come from the house roof with the rain through the conductor into the barrels? A. Credible witnesses have testified to such occurrences as the above too many times for the matter to be laughed out of court. So we close this discussion by saying as we said at first that each instance must be carefully scrutinized and judged by itself. Nor should we decide that these small creatures came from the clouds, if there is any other way for them to appear.

(12780) W. R. asks: Will you have the kindness to get me through your valuable columns the opinion of your authority on languages on the following subject? I have been informed that the vocabulary of the German language comprises about *twice* the number of words which are contained in the vocabulary of the English language. To prove this, it was said that the new Murray's "Dictionary of the English Language" is supposed to have 250,000 words, while the Grimm's "Woerterbuch der Deutschen Sprache" after completion will have about one half of a million expressions. I should like to be informed whether this statement finds your approval, and thank you in advance for your courtesy in answering through your publication. A. We can give no decision as to the relative number of words in the German and English languages. We referred it to a college professor in English, and he said that a decision was impossible. The "New Dictionary of the English Language" is not anywhere near completion, and many of the added words in this truly standard work are words from old writers, not now in use; the German dictionaries contain many phrases and words made in the peculiar German fashion by stringing words together in a line, as it were, to form one compound term. This every scholar knows. A numerical comparison of the two tongues seems out of the question. A standard of enumeration seems to be required for counting words. Rules to be a guide for determining whether a word shall be counted or not ought first to be agreed upon, before such a comparison can be made. It is just like the claim among the different candidates for first place among English dictionaries. Each publisher determines his own standard, and announces that his work is first in the points which he has decided are the chief points of superiority.

(12781) R. M. B. asks: Will you be good enough to tell me what scientific basis, if any, there is in the theory that to insure health from proper circulation one should sleep only with the head to the north, or at least to the south? I understand that in a general sense it is supposed to be the rotation of the earth; that one should lie with head and feet toward the poles, etc.; but in actual practical experience is it scientifically *proven* that this acts beneficially and the reverse position is hurtful? A. We know of nothing whatever in science to give support to the theory that one will maintain better health by sleeping with his head to the north and the body along the north and south line. It may be so. We cannot prove that it is not so. Many believe it to be so. We do not see how any one can carry out this practice in a sleeping car. Probably there are more who sleep in other positions than who sleep in the meridian. Nor do we suppose that health is the sole possession of those who sleep in the north and south line. If there is any basis for this belief, it would we think be due to the earth electric currents, rather than to gravitation or centrifugal force.

(12782) A. D. asks: What is the ratio of expansion of water into steam? A. Water expands about 1,700 volumes in changing into steam, so that it is a common expression that a cubic inch of water makes a cubic foot of steam. At 212 deg. Fahr. and normal pressure the weight of a cubic foot of steam as given by Kent, in his "Mechanical Engineers' Pocket Book," price $5, is 0.03732 pound, and the weight of a cubic foot of water is 62.4 pounds. This would give an expansion of 1,675 volumes.

(12783) W. S. asks: 1. Does brass expand or contract with heat? A. Brass expands in length about 0.002 for a change of 1 deg. Cent. 2. What is the pressure of freezing water per square inch? A. The freezing point of water is lowered 0.0072 degree per atmosphere of increased pressure up to 700 atmospheres, as was proved experimentally by Sir James Dewar. Hence under a pressure of 1,000 atmospheres, or about 15,000 pounds per square inch, water would not freeze at a temperature of 7.2 deg. Cent. It would also be inferred from this that this pressure would melt ice at this temperature. A rough statement of this fact is that one ton per square inch lowers the freezing point 1 deg. Cent. 3. What is the exact atmosphere pressure per square inch at sea level? A. The normal barometer at sea level is taken as 29.92 inches of mercury, or 14.7 pounds pressure per square inch. 4. How many metals, if any, contract with heat? A. There is no metal which contracts with heating. There are some alloys which have so small a coefficient of expansion that it is negligible for any ordinary length. An alloy consisting of 36 per cent nickel and 64 per cent iron has so small an expansion that 19 miles of it would expand only one inch for a change of 1 deg. Fahr. This is called invar. Pendulums and measures made of it may be taken as invariable in length for any moderate change of temperature. Solid silver iodide contracts upon heating between −60 degrees and +142 degrees, according to Ganot's "Physics," edition of 1910, page 313. Stretched India rubber also contracts when heated.

(12784) R. R. W. asks: Will you please advise me as to the following: If the Pacific Ocean at the western end of the Panama Canal is higher than the Atlantic Ocean at the eastern end, and also how much higher. A. The Atlantic and Pacific oceans are at the same mean level at the two ends of the Panama Canal; but the tides at the Pacific end are 20 feet, rising and falling 10 feet each way from mean sea level, and at the Atlantic end the tides are about 18 inches, the water rising and falling 9 inches from mean sea level. These figures are furnished us by the Isthmian Canal Commission. Your designation of the ends of the canal as eastern and western is not quite correct, because the Atlantic end of the canal is farther west than is the Pacific end. Colon is farther west than Panama. The canal lies in a general direction northwest and southeast, with the southeast end at Panama on the Pacific Ocean. The Isthmus, where the canal cuts it, runs northeast and southwest.

NEW BOOKS, ETC.

THE GRAMMAR OF SCIENCE. By Karl Pearson, M.A., S.R.S., Professor of Applied Mathematics and Mechanics, University College, London. Part 1. Physical. Third edition, revised and enlarged. London: Adam & Charles Black, 1911.

Ten years ago Pearson's "Grammar of Science" was regarded almost as a revolutionary book. Its bold abandonment of "matter" and "force" as fundamentals in science gave rise to a hot controversy. Most of us are now prepared to agree with Prof. Pearson where twenty years ago we would have been inclined to differ. During that period science has become more idealistic. As Prof. Pearson says: "No one believes now that science *explains* anything; we all look upon it as a shorthand description, as an economy of thought." In this new edition of "The Grammar of Science," the author tells us: "All that it has been possible to do has been to add a chapter indicating what the author thinks to be the expansion taking place in our ideas of causation." For Prof. Pearson believes that beyond such discarded fundamentals as "matter" and "force" lies still another fetish "amid the inscrutable arcana of even modern science, namely, the category of cause and effect. Is this category anything but a conceptual limit to experience, and without any basis in perception beyond a statistical approximation?" In a chapter on modern physical ideas, the author indicates that "the physicists are discovering a new perceptual reality, but that they are seeking for a mathematical concept wide enough to describe a much enlarged perceptual experience." Because of these two new sections, the book had to be divided into two parts.

PHYSIOLOGICAL OPTICS. By George J. Burch, M.A., D.Sc. Oxon., S.R.S. Oxford: The Clarendon Press, 1912.

The author of this book has conducted classes in physiological optics at Oxford in the course required by the regulations for the diploma in ophthalmology of the University. Written as it is for a special institution and for a special course, it may not meet all the requirements of other institutions. Still, the descriptions are for the most part so general, that other teachers will surely find the book of use. The instructions given are intended to make the student to a great extent independent of frequent reference to the demonstrator. The experiments vary in complexity. Some require but a few minutes only; others, several hours. The author has distinguished those which are very important from those less so by means of asterisks. The six sections of the book bear the following headings: Dioptrics, Dioptrics of the Eye, Judgments of the Eye Space, Sensations of the Eye, Measurements of Color Sensations, Experiments by Flashing Light. The book may be commended for its excellent systematic treatment of a difficult subject and for its lucid phraseology.

LES HYDROAEROPLANES. Par Pierre Rivière, ingénieur. Préface de A. Tellier. Un vol.; illustré. Paris: Librairie Aéronautique, 40 rue de Seine. Price, 3 francs.

M. Rivière has given us a very instructive book on the development of the hydro-aeroplane from the first experiments of Fabre and Curtiss to the present day. He has also critically analyzed the conditions that must be met by a successful hydro-aeroplane and shows why the early types of Fabre and Curtiss were defective. Indeed, the system of supporting the wings by floats carried near the outer ends of the wings and combining the floats with wheels, so that the machine may run on land as well as on water, must eventually be abandoned. The real hydro-aeroplane is the flying-boat type, the credit for having devised which must be accorded to Curtiss, although our author is inclined to think otherwise. Rivière's book may be heartily recommended as a useful discussion of an important phase in the development of the flying machine.

HANDBUCH NEUZEITLICHER WOHNUNGS-KULTUR. Band Herrenzimmer. Darmstadt, 1912. Alexander Koch.

A remarkable change has come over the spirit of German art and architecture within the last twenty years. Instead of blindly following the French example, Germans have deliberately struck out for themselves in the effort to evolve a really national art. Naturally in this effort to achieve artistic independence, much was created that was riotously extravagant and even outrageous. But the analytical German mind and the wholesome influence of the soberer critics exercised a tempering influence. Nowhere is this German ambition to become artistically independent more apparent than in domestic architecture. A type of dwelling has been created which is distinctive in character. Alexander Koch's periodicals *Innen Dekoration* and *Deutsche Kunst und Dekoration* have done yeoman work in popularizing the best of the new ideas. If we may judge from the volume which lies before us, and which is devoted to *Herrenzimmer* (studies, libraries and the like) it is Mr. Koch's intention to collect in book form the better examples of the German architect's and interior decorator's efforts at home beautifying. The volumes are beautifully printed and splendidly illustrated. To American architects they ought to be most welcome for their suggestiveness. While a certain stiltedness is apparent in much of the furniture and decorations illustrated, there can be no question that, with some modifications, the designs presented are of permanent value. It is a far cry from the *Spiessbürger* or intensely bourgeois idea of home furnishing to these highly artistic and comfortable arrangements.

HOTEL PURITAN.